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Factors Influencing Calcium Intake and Foodservice Satisfaction in South Carolina Middle School Children

Vivian Bowie Pilant

To the Graduate Council:

I am submitting herewith a dissertation written by Vivian Bowie Pilant entitled "Factors Influencing Calcium Intake and Foodservice Satisfaction in South Carolina Middle School Children." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Human Ecology.

Jean D. Skinner, Major Professor

We have read this dissertation and recommend its acceptance:

Betty Ruth Carruth, Dileep S Sachan, Sandra Twardosz

Accepted for the Council:

Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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Vice Chancellor and Dean of
Graduate Studies

FACTORS INFLUENCING CALCIUM INTAKE AND FOODSERVICE SATISFACTION IN SOUTH CAROLINA MIDDLE SCHOOL CHILDREN

A Dissertation
Presented for the
Doctor of Philosophy
Degree
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Vivian Bowie Pilant
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DEDICATION

This dissertation is dedicated to my parents, Nora Bowie and Wade Bowie (deceased), who have always encouraged and believed in me; and to my husband, Tom Pilant who has accompanied me on this pathway of the heart.

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ABSTRACT

Objectives The primary purpose of this intervention study was to increase the calcium intake of children in selected South Carolina middle schools. A secondary purpose was to describe the relationship between South Carolina middle school children's perceived satisfaction with their school foodservice pre- and post-intervention. Sub-objectives were to determine if satisfaction was related to students' perception of having a choice in school lunch participation and to identify the foodservice-related factors that predicted satisfaction. Strengths and weaknesses of the methodology used in the study were evaluated. A third purpose was to understand the school eating environment in middle schools by determining foods and beverages available to children during the lunch period.

Design A pretest/posttest randomized intervention/control group design was implemented. Schools were selected based on enrollment and current participation in the school breakfast program from a larger pool of 163 middle schools in South Carolina. The assessment of the availability of foods and beverages in each school was an observational study conducted only once.

Subjects/setting Ten intervention and 10 control schools participated. Students from selected classes in grades 6-8 completed pre- (n =1034) and post- (n=1049) 24-hour food recalls and school foodservice satisfaction surveys (SFSS), pre- (n=980) and post- (n=836).

Intervention Teachers, foodservice managers, and district directors in the intervention schools were provided in-service training about the study goals, information about the

importance of calcium intake in middle school children, and possible strategies to increase children's calcium intake. Teachers also received supplemental materials that focused on increasing calcium intake for children in grades 6-8. Control schools did not receive training or supplemental materials about calcium.

Main outcome measures Based on pre-and post-intervention 24-hour food recalls changes, calcium intakes were determined for intervention vs. control groups. Calcium intakes were determined for breakfast vs. no breakfast consumption groups. Changes in satisfaction with school foodservices were assessed by the SFSS pre- and post- the intervention. SFSS scores of students who perceived they had a choice in eating school meals were compared to those who perceived they did not have a choice. Factors relating to students overall satisfaction with school foodservice were determined. Strengths and weaknesses of the research were identified. Foods and beverages available for sale during lunch periods in vending machines, school canteens, and school cafeterias were identified.

Statistical analyses performed Statistical analyses included group means of calcium intakes (mg/day), univariate analysis of variance (UNIANOVA), chi-square tests, Tukey HSD, and Pearson correlations. Scoring of the SFSS was based on a 7 point hedonic scale with 1 = lowest and 7 = highest. General linear models (GLM) were used to test differences pre/post intervention changes in SFSS scores for intervention vs. control students. Posttest SFSS scores of the choice vs. no choice groups were tested with GLM. A stepwise regression analysis of students' responses to the SFSS questions was performed to identify variables that contributed significantly to overall satisfaction with

school foodservice. The mean scores of foods and beverages other than school lunches available to students during lunch periods were counted.

Results The intervention was not successful in improving children's dietary intake of calcium nor in increasing children's satisfaction with their school's foodservice program. Pretest/posttest changes in calcium intake and foodservice satisfaction were not significant and did not differ between intervention and control schools. The posttest calcium intake means were 719 mg and 666 mg in intervention and control groups respectively. These intakes are considerably below the recommended Adequate Intake (AI) of 1300 mg/day. Males consumed significantly more calcium than females ($p<0.001$), and this difference persisted after controlling for males' greater energy intakes ($p<0.01$). However, males' mean calcium intake was only 64.1 % and females/ intake 47.5% of the AI. Students who ate breakfast had significantly higher mean intakes of calcium than students who had no breakfast [789 mg vs. 487 mg calcium, ($p<0.05$)], but still > 500 mg. less than the AI.

Students who perceived they had a choice had significantly higher scores on overall foodservice satisfaction ($p<0.05$) and on the 5 satisfaction factors than did the no choice group. Seven of the SFSS questions measured over 53% of the variance in overall foodservice satisfaction ($p<0.001$), among the students who felt they had a choice.

Strengths of the study included the randomized pretest/posttest intervention/control group design, successful recruitment of schools, and data collection and analyses. Weaknesses in the study included student recruitment issues related to return of parental permission forms, lack of a formal process evaluation of the classroom intervention or the cafeteria component, no pilot testing of intervention materials with

South Carolina students, and a compressed timeline due to initiating study during the last 4 months of the school year resulting in a short duration for the intervention.

The mean number of food and beverage items available in addition to school lunches was 21.7 with a range of 0-62 item in the 20 schools.

Applications/conclusions While the intervention was not successful in changing patterns of calcium intake, intakes below recommendations confirmed the need for an effective calcium intervention. Because 28% of these middle school students skipped breakfast and breakfast consumption was positively related to calcium intake, strategies for increasing breakfast consumption at school should be explored. Addressing the low calcium intakes of middle school children through a supportive school environment and policy changes should be a priority. Extensive choices of foods and beverages of low nutritional value were available to South Carolina middle school children during lunch periods. School districts should consider adopting policies and standards for all foods and beverages available in schools during lunch periods.

Students' satisfaction with school foodservice was related to food quality, including availability of choices and foods liked by students as well as appearance of the food. Smiling and greeting students by foodservice staff was also an important factor in students' satisfaction with school foodservice. Staff may play an important role in providing food choices that appeal to middle school students and ensure the school meal programs provide adolescents the nutrients they need.

Conducting research in middle schools is feasible. However, adequate planning is essential, and careful monitoring of interventions at the individual student, classroom, cafeteria, and school level is important.

PREFACE

As an aid to the reader, a description of the organization of this dissertation follows. Part 1 contains a review of the literature, and Part 4 is an evaluation of the overall study. Although not part of the original proposal, the evaluation section was added to explore possible reasons for no positive/significant findings. Parts 2, 3, and 5 contain the study results, written in journal style as 3 articles to be submitted for publication. Finally the Appendices provide a comprehensive description of the methodology for the overall study and other materials related to the study.

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Part 1

Review of Literature

INTRODUCTION

To plan a nutrition education intervention, one must understand the target audience, their environment, and the characteristics of successful and unsuccessful previous interventions. This literature review provides information about children in early adolescence, the age typically found in middle school grades 6-8. An overview of children and adolescents' growth and development, nutritional needs and dietary intake, and the contributions of school meals to students' nutrient intakes is provided. This review has a specific focus on calcium because adolescents usually have significantly lower dietary calcium intakes than is recommended [1-4]. This is of particular concern because low intakes of calcium coincide with a period of rapid skeletal growth that is considered a "window of opportunity" to maximize peak bone mass and protect against risk for osteoporosis [5].

A description of several national programs attempting to address nutritional and health issues of school children including the coordinated school health movement and related programs is provided. There is also a brief description of trends in changing the school environment to better meet the needs of developing adolescents.

This review contains a summary of 30 school-based nutrition-related intervention studies conducted from the late 1970s to the present. During the 1980s, the increasing consensus that diet was related to chronic diseases renewed an interest in the school as a potential setting for prevention education [6]. Large, multi-component behavioral-based nutrition interventions indicated health behaviors of children in schools and communities

could be improved [7]. However, while desired results were found, the positive outcomes have been cited as weak in comparison to the resources involved [8].

In summary, this review of the literature on adolescents, their growth and development including calcium intake and bone accretion, their school environment, and a review of previous nutrition education intervention studies provides insight for understanding the adolescent and assists in planning future nutrition education interventions.

ADOLESCENT GROWTH AND DEVELOPMENT

Early adolescence (ages 11-14), includes major pubertal and cognitive changes and is generally the ages of adolescents in middle school grades 6-8 [9]. Nutrition is especially important to middle school children due to the physiological, cognitive, emotional, and social development changes and issues surrounding the developing adolescent. Changes that occur during adolescence can affect eating behaviors and nutritional health [10].

During cognitive development, there is a transition in style of thinking from concrete, operational thought to formal, operational thought [11]. In providing nutritional counseling and nutrition education interventions to this age group, it is important to understand the cognitive level of the adolescent [12]. Concrete thinkers respond best to simple, straightforward messages while abstract thinkers are more able to understand complex messages and master complex problem solving and decision-making.

A major influence on nutrient requirements during this period of the life cycle is the velocity of growth that affects both height and weight. The phenomenal growth during adolescence is second only to the growth that occurs during the first year of life

[13]. The average American female experiences her most rapid spurt in linear growth between ages 10 and 13 years and the average American male about 2 years later, between 12 and 15 years [14]. The timing of the onset of this growth, termed *the period of maximum growth,* is highly variable and is greatest in girls in the years preceding menarche. Males tend to gain more weight at a faster rate, and skeletal growth continues for a longer time than that of females. Males become leaner and deposit more muscle mass; females deposit relatively more total body fat [13].

Calcium and bone accretion

Calcium intake during childhood, especially during the years just before and during the peak growth velocity of adolescence, is important to development of peak bone mass (PBM) [15, 16]. Achieving maximum peak bone mass (PBM) is considered a primary prevention strategy for osteoporosis and fractures in later life as well as fractures in younger years [16-25]. PBM is considered the result of interaction between endogenous (heredity, endocrine) and exogenous (nutrition, physical activity) factors [17]. Low calcium intake during adolescence is associated with low bone density and an increased risk for osteoporosis later in life [26].

During the pubertal process adolescents attain approximately 15% of their final adult height, about 50% of their adult weight [27], and accumulate up to 50% of their adult skeletal mass [28]. In girls, stature growth ceases at a median of 4.8 years after the onset of menarche or at a medium age of 17.3 years; in boys, stature growth stops at a median age of 21.2 years [27] and covers approximately a six-year period [28].

The mechanisms for variation in bone accretion and resorption with age and dietary intake are unknown, but hormonal factors may be involved [29]. The peak calcium accretion rate typically occurs at mean age 13 years for girls and 14.5 years for boys [5]. In studies using isotopes of calcium on girls, early pubertal girls retained slightly less than 200 mg calcium/ day compared to approximately 50 mg/day in late pubertal girls [29]. Isotope studies of calcium have not been performed on boys, but researchers suggest they are needed [28]. Similar data from a growth study on pubertal boys and girls estimated that boys and girls accumulated 282 mg of calcium/day and 212 mg/day respectively [5].

Recent studies [30, 31] add information on calcium accretion. A longitudinal study on whole body bone mineral accretion of boys and girls aged 6.5-19.5 years confirmed the close relationship between pubertal stages and gain in bone mineral content (BMC) and bone size for regional bone mineralization [30]. Studies have also shown that weight-bearing physical activity by youths, beginning in pre-puberty, results in greater accrual of bone mass [28, 32-34]. The Institute of Medicine's recommendations for calcium (1300 mg/day) [35] did not consider a possible interaction with calcium and physical activity as a determinant of bone mass and bone density early in life [28]. The level of adequate calcium needed for the accrual of bone mass during the prepubertal and pubertal growth periods may vary according to the amount of physical activity of boys and girls during those periods of growth [28].

DIETARY NEEDS AND QUALITY OF DIETARY INTAKES OF ADOLESCENTS

Rapid physical growth creates an increased demand for energy and nutrients. Healthy eating behaviors during adolescence is essential for (1) promoting optimal growth, development, and health; (2) preventing immediate health problems; and (3) laying the foundation for lifelong health and reducing the risk of chronic diseases [13].

Dietary practices during adolescence may have long-term health implications [26]. Failure to consume an adequate diet during adolescence can potentially affect growth and delay sexual maturation [36]. In the short term, eating practices can affect children's risk for a number of immediate health problems, such as eating disorders, obesity, undernutrition, and bone health [26]. Additionally, skipping breakfast, which is common among adolescents, may affect concentration, learning, and school performance [37, 38].

Dietary recommendations for adolescents are based on estimates of intakes associated with good health and growth, extrapolated from animal research, and/or interpolated from studies on children and adults [14]. The Dietary Reference Intakes (DRIs) provide a set of four nutrient-based reference values designed to replace the earlier Recommended Dietary Allowances (RDAs) [39] in the United States [40]. These reference values include Estimated Average Requirement (EAR), Recommended Dietary Allowance (RDA), Adequate Intake (AI), and Tolerable Upper Intake Level (UL). To date, several volumes in this series of DRIs for various nutrients or combination of nutrients have been published [40].

Estimates of calcium intake needed to attain a desirable level of calcium retention were the basis for setting the Adequate Intake (AI) of calcium for both boys and girls 9-

18 at 1,300 mg/day for the United States and Canada in 1997 [35]. Because most of the studies used to establish the AI were conducted with girls and specific data on boys were not available, a gender specific AI was not established.

Many healthy children in the U.S. do not consume sufficient dietary calcium to meet the recommendations [16, 20, 41, 42]. Data from national studies (1994) indicate a mean calcium intake of 889mg/ day in girls ages 9-13 years and 713 mg/day in girls ages 14-18 years [43]. The Healthy Eating Index (HEI), developed to assess overall dietary quality, was used to examine the diets of U.S. children, ages 2-18 years, based on 1994-96 nationally representative survey data. In the HEI study, only 12 % of adolescents ages 15-18 years met the dietary recommendations for milk [44].

Nutritional quality of meals away from home

The nutritional quality of away-from-home meals has played an increasingly important role in determining the overall quality of diets of children and adolescents. Twenty percent of children's snacks were obtained away from home in 1994-96, up from 13 % in 1977-78 [45]. Meals eaten away from home by children rose from 17 % in 1977-78 to 30% in 1994-96, with school-age children eating about 33% of their meals away from home. During 1977-78, school meals accounted for 63% of all meals children ate away from home. This declined to 36% in 1994-96 due to the increasing popularity of eating at fast food places and restaurants. While only 1 to every 10 meals eaten away from home by children was purchased at a fast food place in 1977-78, this proportion rose to 1 in every 3 away-from-home meals in 1994-96 [45].

Calcium density in foods provided at home during 1977-78 was less than away-from-home meals because of high calcium density available in school meals [45]. By 1994-96 a larger share of children's away-from-home meals were eaten at fast food restaurants or included foods provided by them. From 1994-96, school food provided an average of 724 mg of calcium/1000 kcal for boys age 6-11years, and 619 mg of calcium for boys, ages 12-17 years. For girls ages 6-11 (1994-1996) the calcium/1000 kcal was 764 mg but it dropped to 496 mg/ 1000 kcal for girls ages 12-17 years. In 1977-78, school food programs provided 605 mg of calcium/1000 kcal for girls ages 12-17 years and 619 mg of calcium for boys ages 12-17. Teenage boys maintained the amount of calcium they obtained form school foods from 1977-78 to 1994-96 but they consumed less calcium–rich food at school than younger children [45].

These data suggest that although calcium-rich foods are still available in school cafeterias, adolescent girls particularly, are increasingly less likely to choose them, given their other food options [45]. The decrease in calcium consumption has been attributed to soft drinks that often serve as a replacement for milk [15]. Beverage consumption, particularly soft drinks, rose especially for adolescent males from 1977-78 to 1994-96 [46]. Despite this, school meal programs in the United States are an important safety net, especially for food-insufficient individuals, and play an important role in meeting children and adolescents' nutritional needs. This leads to a review of the contributions of the United States school meal programs in meeting adolescents' nutritional needs.

ROLE OF FEDERAL SCHOOL MEAL PROGRAMS IN MEETING CHILDREN AND ADOLESCENTS' NUTRITIONAL NEEDS

Over $7.9 billion was provided for meals and milk served to children in 2000-2001 [47]. The major programs are the National School Lunch, School Breakfast, Food Distribution, and After School Snack Programs. Federal payments for meals served in 2001 were $5.6 billion for school lunches, $1.5 billion for school breakfasts, with $0.9 billion provided in donated commodities [47]. The After-School Snack program in schools is a relatively new program, and national nutritional analyses do not include the contributions of this new initiative to bring nutritious foods to the nation's school-age children [48].

Over 27 million children receive National School Lunch Program (NSLP) lunches daily, and approximately 7.8 million receive breakfasts in the School Breakfast Program (SPB). The NSLP operates in more than 99,000 public schools and private nonprofit schools and residential child care institutions [49]. Schools receive Federal subsidies (cash reimbursement and donated commodities) for all meals served in the NSLP and SBP. These meals are required to meet the applicable recommendations of the Dietary Guidelines for Americans [50]. Federal regulations also establish a standard for school lunches to provide one-third and school breakfasts one-fourth of the 1989 Recommended Dietary Allowances (RDA) [39] of protein, vitamin A, vitamin C, iron, calcium, and food energy to be eligible for the NSLP and SBP reimbursements [51]. National representative studies have shown that both programs meet and exceed these goals [52, 53]. Mid-1990 studies found that participation in the SBP had significant effects on students' breakfast intakes of food energy, protein, riboflavin, calcium, phosphorus, and magnesium and on students' 24-hour intakes of these same nutrients, except for riboflavin [54, 55].

Children from low-income families received 56.8 % of the total lunches served and 83.2 % of total breakfasts served in the United States school meal programs in 2001-02 [56]. While these children were provided meals free of charge or at a reduced price, because they are subsidized by the federal government, other children pay a larger share of the meal cost, usually referred to as a "paid meal," with less government assistance [49]. Students who consume school meals under the NSLP and the SBP are more likely to meet the recommended reference dietary intakes than students who do not participate in these programs [26, 36, 46, 53, 54, 57-60].

Breakfast, including school breakfast, makes a significant contribution to essential nutrients, particularly calcium [55, 60]. Additionally, participation in school breakfast programs are associated in the short-term with improved student functioning on a broad range of psychosocial and academic measures [26, 38, 61]. National and regional studies show that as many as 22-35% of youth skip breakfast [55, 62, 63]. Breakfast skipping is more prevalent in females and black youth and increases as the child matures from childhood to adolescence [46, 64]. Breakfast skipping has been identified as a risk factor for adolescent overweight [64].

Current status of school breakfast in the United States

The Food Research and Action Center (FRAC), a long-term advocate for breakfast at school, publishes annual reports of the SBP [65]. Because the NSLP is available in 95% of schools nationwide, FRAC used school lunch as a benchmark to measure the rate of school participation in the SBP. Nationwide, 76 % of the schools offered both the NSLP and SBP in school year 2001-2002. School breakfast effectiveness in reaching low-

income children was also measured and was defined as the ratio number of free and reduced price meals served to students at lunch and at breakfast.

The 2002 FRAC report, based on School Year 2001 data, indicated that 15 states, including South Carolina and the District of Columbia, provided both the NSLP and the SBP in 90% or more of their schools; on the lower end of the spectrum, 12 states provided 60% or fewer of both programs in their schools [65]. In reporting effectiveness of existing breakfast programs to reach free and reduced price eligible children, FRAC compared the number of the free and reduced price students who participated in the NSLP to the SBP participation. FRAC reported that 12 states provided free or reduced price breakfasts to 50 children or more for every 100 free or reduced price lunches served (range 50%–56%). Most of those states were in the South. Of the 15 states that had 90% or more schools offering both programs, South Carolina had the highest number of schools participating, 100% in the SBP. In the effectiveness component of the FRAC assessment, South Carolina had 52 out of every 100 free and reduced price lunch participants also participating in breakfast.

ROLE OF SCHOOLS IN FOSTERING THE DEVELOPMENT OF HEALTHY EATING HABITS

The scientific consensus on the relationship of diet to disease has compelled more attention be paid to the kinds of meals provided in public programs such as the school breakfast and lunch programs [66]. Studies indicate that physiological risk factors track from childhood into adulthood [67]. Results of longitudinal tracking of adolescent smoking, physical activity, and food choice behaviors provided evidence that health-

related interventions, including food behaviors, should begin prior to sixth grade, before behavioral patterns become resistant to change [67]. The role of schools in promoting the development of healthy eating behaviors has been the focus of federal regulations governing school meal programs, structural changes in the middle grades of school, coordinated school health programs, and the school-based nutrition education intervention programs.

The U.S. Department of Agriculture through the School Meal Initiative of 1995 [68] required school meal programs to meet the *Dietary Guidelines for Americans* [50]. This initiative coincided with the release of "Guidelines for School Health Programs to Promote Lifelong Healthy Eating" by the Centers for Disease Control [26]. The document provided strategies that would most likely be effective in promoting healthy eating among school-age youth and provided nutrition education guidelines for comprehensive school health programs [26]. USDA more recently launched a collaborative Team Nutrition Project called "Changing the Scene: Improving the School Nutrition Environment" which provides a guide for local action [69].

Middle schools in South Carolina have been undergoing changes to reflect the characteristics and needs of early adolescents summarized in *Turning Points* [9]. These changes involved transforming a curriculum based junior high system modeled after high schools to a middle grade level incorporating grade levels 6-8 [70]. One of the tenets proposed in *Turning Points* was to improve academic performance through better health and fitness of the individual and ensuring a health-promoting environment.

Based on evidence derived from the National Longitudinal Study of Adolescent Health (75,535 students in 127 schools), researchers concluded that the concept of school

health promotion should be expanded beyond health education, physical education and health services. Adolescent health should be promoted by fostering a school environment that meets adolescents' developmental needs to feel like they belong and are cared for at school [71]. To foster strong school "connectedness" and help adolescents avoid unhealthy behavior, it was suggested that schools build comprehensive health programs to include health services for poor students, nutritious meal programs, physical education, counseling, health education, health programs for faculty and staff, and family and community involvement [72]. The Coordinated School Health Program is a model for fostering these goals.

Coordinated school health

A comprehensive school health program (CSHP) was proposed in the 1980s to address many of the health-related problems of children and youth [73]. In 1994 the Division of Adolescent and School Health (DASH), Centers for Disease Control and Prevention (CDC), assisted in defining comprehensive school health programs and their components and in providing action steps for implementation at the local, state, and national levels [74]. The School Health Policies and Programs Study 2000, (SHPPS 2000) [75], was the first study to assess the school health program components and to provide comparison information for schools to use in evaluating their programs.

Healthy People 2010

Another national project that has the potential for helping focus on comprehensive health issues that apply to all Americans is *Healthy People 2010* [76]. In the process of developing *Healthy People 2010*, a broad range of leading health indicators was

considered. Two goals related specifically to calcium intake and school nutrition environments were 19.11 and 19.15. Goal 19.11 involves increasing the proportion of persons ages 2 years and older who meet dietary recommendations for calcium. Goal 19.15 was to increase the proportion of children and adolescents ages 6 to 19 years whose intake of meals and snacks at school contributed to good overall dietary quality. The latter goal (19.15) was added to reflect that students have increased food options at schools. Although students may understand that good nutrition and good health are connected, that understanding may not be reflected in their food choices and meal patterns. Improving the quality of students' dietary intake in the school setting was cited as important because meals and snacks consumed at school make a major contribution to the children's total daily consumption of food and nutrients [76]. The establishment of an environment that supports a good overall diet would enable school nutrition and food services, in conjunction with students, to make an important contribution to short-term and long-term disease prevention and health promotions [76]. The concern about inadequate consumption of calcium by children and adolescents prompted several U.S. government agencies and national organizations to address strategies that may reverse these trends [69, 77-81].

Projects and educational efforts to improve the school environment

Other national nutrition related projects focus on improving the school environment and promoting the integration of the NSLP and SBP within the school environment. The U.S. Department of Agriculture (USDA) has developed a Team Nutrition *Changing the Scene* tool kit that is designed to assist school personnel in improving the school nutrition

environment in schools and to promote the adoption of healthy eating habits [69]. To date, over 13,000 tool kits have been distributed nationwide. Additionally, the American School Food Service Association, the American Dietetic Association, and the Society of Nutrition Education adopted a position paper on school-based nutrition programs and services that promote the integration of the NSLP and SBP with the school curriculum, the school environment, and the community [82].

SCHOOL-BASED NUTRITION EDUCATION INTERVENTION STUDIES

Introduction

There is a growing consensus that school-based nutrition intervention programs can play an important role in promoting lifelong healthy eating, and that nutrition education programs must become a national priority [26, 76, 82-85]. Establishment of healthful eating patterns among children and adolescents has been purported to be more successful if the program development was guided by behavioral theories, had multiple intervention components, including classroom curricula and school foodservice changes, and if healthy eating was promoted and coordinated through a comprehensive school health program [86-91].

A literature search of school-based nutrition education research studies in the United States was conducted to determine the effectiveness and the possible reasons for the results obtained. Over 50 articles spanning the late 1970s to the present were reviewed. Several articles related to the same study or studies leading to the inclusion of only 30 school-based nutrition education intervention studies as shown in Tables 1-8. Few of the nutrition-education related intervention studies included the early adolescent,

ages 11-14 years. Therefore, studies of school-age children below the 6th grade or preadolescents were included as were studies of older adolescents. The studies are grouped into 8 tables based on similar characteristics such as funding, time, focus, components, or age group. Conclusions about the effectiveness or lack of success and the possible reasons for the results will be reviewed for their usefulness in planning nutrition interventions.

In this 25-year period covered by these studies, a major shift occurred from the general acquisition of knowledge, attitude, and skills and the prevention of nutritional deficiencies to the adoption of health behaviors that reduce the risk for developing chronic, diet-related diseases. Dietary guidance provided to Americans during this period, including children age 2 and over, also reflected this shift. The shift is illustrated by the studies. Funding sources also influence the study foci and will be discussed in the text. The studies included in the tables are published nutrition education intervention studies; other non-intervention studies will be referenced in the text as appropriate.

Evolution of nutrition education programs from the 1970s and 1980s to the present

Nutrition education research studies in schools have evolved over the past 25 to 30 years and reflect changing goals for nutrition education. A major impetus for nutrition education in schools in the late 1970s and early 1980s was the passage of the Child Nutrition Amendments of 1977, Public Law 95-166 [51], that created the Nutrition Education and Training (NET) program. This was the culmination of a growing interest in nutrition from the previous decade that was heightened by the 1969 White House Conference on Food, Nutrition, and Health. The nutrition panel's report from that

meeting recommended the development of "a comprehensive and sequential program of nutrition education to be included as an integral part of the curriculum of every school in the United States..." (page 151) [92].

With funds provided by the NET program, individual states conducted needs assessments and developed curricula and materials for nutrition education that sought to establish an integrative, sequential curriculum [6, 93-96]. A common approach to establishing such a program was that described in the literature by the states of Tennessee and Pennsylvania [93, 96-98]. Curricula for kindergarten through grade 6 were developed for integration into several subject matter areas, whereas secondary curricula were developed for teachers in health, home economics (family and consumer science), science, and social studies.

Studies funded by the USDA Nutrition Education Training Program

The impact on students of the nutrition education curricula and other NET projects, whether they were successful or not, have been published for some studies and are listed in Table 1 [93, 94, 97-100]. While the outcomes focused on students' change in knowledge and attitude, two of the study designs also considered the effectiveness of teacher preparation and support in implementing the curriculum [93, 99]. In the first study [99], a nutrition fitness curriculum was only partially successful in increasing knowledge and attitude scores of 5th and 6th graders. Teacher teams who had a consultant work with them during curriculum implementation were most effective in fostering consistently positive nutrition knowledge and attitude changes in their students. The outcomes of the studies were mixed. Knowledge was usually increased but not for all

Table 1. Studies funded by the USDA Nutrition Education and Training Program. [a] [55]

Study	Sample	Study Design	Intervention	Nutrition Education/ Intervention Targets	Success[b] Yes	No	Partial	Comments on Results
Evaluation of implementation methods using a nutrition-fitness curriculum [99]	•1394 students •50 fifth and sixth grade classes •22 schools in 12 school districts in AZ •Four months field test of instruction in •Urban and rural •Multiethnic •Females and males	•Experimental (E) •Randomized pretest/posttest studies •Complete block with 3 methods of teacher training for test groups •Intervention (I) schools (17) •Consultant (6) •Workshop schools (6) •Orientation schools (5) •Control (C) schools (5) •Three methods for training teacher teams	•Intervention (I) teams received curriculum kit, orientation, •Parent involvement •School nurse and school food service part of teaching team •Curriculum 20 hours •Control (C) group no intervention	•Increased Knowledge (K) •Change in Attitude (A) (reflecting feelings about relationships among a nutritious diet, good heath, and fitness)		X X		•Sixth graders mean scores on K-test and A-scales were positive for all study groups but not for 5th graders •Consultant group K test significantly higher than control group •Consultant/ orientation group A scores were significantly higher than other treatment and control groups.

Table 1. Continued.

Study	Sample	Study Design	Intervention	Nutrition Education/ Intervention Targets	Success[b] Yes	No	Partial	Comments on Results
Nutrition in a Changing World K-6 integrated nutrition education curriculum evaluation – Instruction and teacher preparation [93]	•2,959 students •156 classes •125 teachers •GradessK, primary,s4,s5,s6 •29 schools in suburban area •broad and even representation of racial, ethnic, socioeconomic groups	•E •I classes (83) •I teachers (64) •Provided new curriculum with three levels of preparation •C classes (73) •C teachers (61) •C no nutrition instruction •Coded pretests/posttests	•45-hour nutrition course for teachers •3shoursinservice for teacher •curriculum guide only for teachers •Curriculum Grades K-3 10 units •Grades 4, 5, 6 10 wks/20 lessons	•Increased K	X			•I students showed significant knowledge gains when compared to controls. In some cases knowledge gains of 4th and 6th grade students were greater when teachers had additional preparation but this was not consistent across all treatments.
Nutrition in a Changing World Nutrition knowledge and attitudes of elementary school students after receiving nutrition education [94]	•GradessK-6 •I and C classes •Part of a broader study, this reports children's responses to nutrition and attitude scales	•E •I classes •C classes •I and C were not in same schools •Pre and posttest design •Attitude scale and knowledge test administered by teachers	•Curriculum lessons/9 wks •Cafeteria, posters, and activity sheets	•Nutrition A scales •Grades K-3 eating -nutritious foods -vegetables -new foods •Grades 4-6 eating -nutritious foods -vegetables -new foods -learning about nutrition •Nutrition K Grades K-3 Gradess4-6	X X X X X X X X	X	X	•Significant effect of I on A scales except new foods •-Lowest A scores on vegetables •Significant effect on K for grades K-5 but not grade 6

Table 1. Continued.

Study	Sample	Study Design	Intervention	Nutrition Education/ Intervention Targets	Success[b] Yes	Success[b] No	Success[b] Partial	Comments on Results
Nutrition in a Changing World Food behavior of elementary school children after receiving nutrition education [100]	•Grades K-6 •3-4 classes in each grade for both I and C groups •Part of a broader study, this reports on children's food behavior	•E •Data collection on consumption of selected items in the school lunch by 1^{st} – 6^{th} grades and snacks in kindergarten for 5 days before and after intervention	•Curriculum lessons/9 wks •Cafeteria, posters, and activity sheets	•Kindergarten snacks •Increase in items:				•Kindergarten children's least accepted snack was improved with nutrition education
				-peanuts and raisins		X		
				-raw carrot/broccoli	X			
				-pumpkin bread		X		
				-apple		X		
				-peanut butter and pineapple cube		X		
				•Grades 1-6 increase				
				- broccoli		X		•Only grades 4-6 had a significant increase in green beans
				- corn		X		
				- green beans			X	
				- spinach salad	X			
				- mashed potatoes		X		
				- stewed tomatoes	X			
				- wheat bread	X			
				- milk		X		
Nutrition in a Changing World Junior High Home Economics curriculum's effects on knowledge, attitude, and behavior [97]	•4 schools •Grades 7, 8, 9 •34 classrooms •11 7^{th} grade •13 8^{th} grade •10 9^{th} grade •Rural, urban, and suburban	•E •I schools one group each grade (foods/nutrition classes) •C schools two groups each grade •I teachers 2 hours instruction •C no classes	•I teachers received curricular guides for use in nutrition instruction •10 lessons taught over 3 to 6 weeks •Student coded pretests/posttests	•Increased K	X			
				•Changes in A			X	•Only 9^{th} graders showed change in attitude
				•Improved dietary behavior (food frequency scores)		X		

Table 1. Continued.

Study	Sample	Study Design	Intervention	Nutrition Education/ Intervention Targets	Success[b] Yes	No	Partial	Comments on Results
Nutrition in a Changing World Nutrition education curriculum for senior high home economics student. [98]	•605 students enrolled in home economics •Grades 10, 11, 12 •16 schools •Rural, urban, and suburban • 55 classrooms • 21 teachers	•E •I students (271) •C students (334)	•5 to 6 weeks of instruction •I pretest/posttest with curriculum • I posttest only with curriculum •C pretest/posttest no curriculum •C posttest only no curriculum •I teachers – 2 hr training session	•Increased K •Change in A (4 scales used) •Self-reported food behaviors (food frequency and food choices)	X	X	X	•One of four scales showed positive change posttest- (nutrition affects health)

[a] I = Intervention; C = Control; FU = Follow-up; PA = Physical Activity; E = Experimental; K = Knowledge; A = Attitude;

[b] Success: Yes = statistically significant (at least $p = <.0.05$) positive change in I when compared to C; No = no statistically significant positive change in I; Partial = statistically significant positive change in some aspect of I group or portion of group and identified in comment on results column.

students; attitudes were changed only in some age groups. Acceptance of foods was limited, and in older students self-reported food and dietary behaviors were not changed.

In the studies reviewed in Table 1, 10 to 20 lessons were included in most of the curricula and were taught over a time period of a minimum of 3-6 weeks and up to 9 weeks. These curricula studies, though not specifically stated, could be an example of the implied use of the theoretical framework of the knowledge-attitude-behavior (KAB).model that was commonly used with general nutrition education interventions [86]. In theory, one would provide information on the assumption that the person who is exposed to this new information will attend to it and gain new knowledge, leading to changes in attitude, which, in turn, would result in improved dietary behavior or practices [86]. According to Contento, for this model to work, the "knowledge" provided must be the motivational kind. Traditional nutrition education focused on the "why" and included curricula that in theory would provide information about nutrients and food sources of the nutrients, the cardiovascular system, the digestive process, etc, so that if children understood how food worked to make them and keep them healthy, then healthful food choices would follow [101]. However, work in the nutrition field indicated that knowledge gain is not related to behavioral change.

In a summary evaluation of the NET program soon after its implementation in 1979 [102], the US Department of Agriculture sought to determine how the program was operating at state and local levels (evaluation data are not shown). The researchers found that the goals of most nutrition education programs were to change children's nutrition-related knowledge, attitudes, and behaviors with the long-range goal of improving nutritional health and health status. After examining state records and reports of the

nutrition education effects on children across several projects in many states, the researchers concluded that positive effects of knowledge were almost universal while effects on attitudes, food preferences, plate waste, and other behavioral measures were not consistent across studies and were confined to specific grade and food-item combinations [102]. In reporting these findings, the authors stated that while knowledge is easily conveyed, it might be unrealistic to expect a 3-10 week program to significantly change behaviors that had been formed over several years. The expectation for the NET program was that greater impact could be expected from nutrition education offered over a period of years throughout primary and secondary schooling [102].

While many states used NET funds to develop statewide nutrition education programs, most state sponsored programs did not conduct outcome evaluations and restricted their evaluations to process evaluations [101]. Consequently, many programs that may have been innovative and creative remained undisseminated because of lack of evaluation.

Generalizing about nutrition education programs, Lytle [101] commented that in studies from the 1970s and 1980s most programs involved only 10 to 15 hours of instruction over a 3-15 week period. This paralleled research on the effectiveness of health education programs published in the mid 1980s [103] indicating that 10-15 hours of health education could be expected to result in effects in program specific knowledge. However, 20 hours were required to achieve changes in health practices, 40 hours were required for changes in attitude, and 50 hours were required to achieve stable levels in knowledge, attitudes, and behaviors [103].

Other studies conducted with adolescents during 1970s and 1980s

The number of published school-based nutrition education studies conducted with adolescents during the 1970s and 1980s was limited. Four studies were identified and reviewed. In all four studies knowledge was increased but attitude and health or food behaviors either did not change or there was partial response by some students. The studies varied in their outcomes and are summarized in Table 2 [104 -107]. One study used a multidimensional evaluation of a food and nutrition minicourse [104]. Changes related to health and food behaviors were evaluated. Knowledge increased, but attitude did not change. Correlations were determined among selected knowledge, attitude, and behaviors but positive changes were infrequent and different in each class.

In another study, a positive behavior change was found in self-reported eating scores and attitude when peer leaders were used to promote healthy eating [105]. However the success was only partial; the improvement was observed in female peer leaders only and was not significant for all their measured behaviors. It did not have a significant effect on male peer leaders or other students.

One study of adolescents from this period produced positive behavioral changes for most but not all students. In this study of high school adolescents, both female and male, a goal setting strategy was used as a component of nutrition education for behavior change [106]. This study is illustrative of how nutrition education research began to shift in focus toward behavioral driven intervention.

Different approaches for nutrition education interventions were being discussed in the literature and at nutrition conferences during the 1980s. The need for theory-driven research was recognized [110] as well as the need for applying a humanistic perspective

Table 2. Other studies conducted with adolescents during 1970s and 1980s.[a]

Study	Sample	Study Design	Intervention	Nutrition Education/ Intervention Targets	Success[b] Yes	No	Partial	Comments on Results
Multidimensional evaluation of a food and nutrition minicourse [104]	•108 students •6 classes •3 schools •Grades 11 and 12 •Females and males	•E •Field study with •I classes (3) •C classes (3)	•I Minicourse •30 hours nutrition instruction by researcher •C no intervention by regular classroom instructors •Pre-and posttests for both groups •Multidimensional evaluation	•Increased K •Change in A •Behavior change (related to health concerns and food choice behaviors)	X	X	X	•Correlations among selected knowledge, attitude and behavior areas were both low in frequency and different in each class. •Poor design as both I and C were in same schools
Pilot study of 'Slice of Life' Promoting healthy eating and physical activity patterns among adolescents [105]	•10 classrooms •Peer leaders •5 students per class •Grades 9 & 10	•E •I classrooms (6) •C classrooms (4) •I students (173) •C students (97) •I males (83) •I females (90) •C males (48) •C females (49) •I peer leaders •pre/post 16 page survey was administered to all students •Process evaluation	•SCT [108] •Curriculum goal eating and physical activity patterns for the prevention of heart disease •3 training sessions for peer leaders •Peer leaders responsible for over half of the program activities •Controls received regular curriculum	•Increased K •Change in A •Self-reported eating behavior •Improved healthy eating score •Reading food labels •Planning changes in diet as result of prog-gram •Increased level of physical activity •Planning changes in physical activity	X	X X	X X X	•Significant for I •I females only •I females only reported positive change •Improvement in females only

Table 2. Continued.

Study	Sample	Study Design	Intervention	Nutrition Education/ Intervention Targets	Success[b] Yes	No	Partial	Comments on Results
Goal setting as a component of nutrition education to effect behavior change among adolescents [106]	•159 adolescents •12 classes -8 intervention -4 control •6 schools •Females and males •95% White •Approximate age 15 years	•E •I classes (8) with 2 treatments •C classes (4) •Pretest/posttest •Goal setting strategy related to 1 of 6 nutrients	•Activated Health Model [109] •Researcher taught •I treatments (2) •Goal setting -8 sessions •Goal setting strategy + nutrition education •12 sessions •C classes (4) no intervention	•Nutrition K •Change in A •Dietary improvement in goal nutrient -↑Calcium -↑Vitamin A -↑Vitamin C -↓Sodium -↑Iron -↑Folic acid	X	X	X X X X X X	•K increase was higher for goal setting strategy plus nutrition education. •Significant behavior change occurred in the I groups with a specific nutrient goal in 4 of 6 nutrients •Effect of changes in folic acid and iron intakes were accounted for by decreasing intake of those nutrients by adolescents who set a goal related to sodium.

Table 2. Continued.

Study	Sample	Study Design	Intervention	Nutrition Education/ Intervention Targets	Success[b] Yes	No	Partial	Comments on Results
The Great Sensations Study Modifying the snack food consumption patterns of inner city high school students [107]	•2 schools •I school (1) •C school (1) •284 students •Grades 10-12 •55% female •I 98% black •C 87% black	•E •I 154 students •C 130 students •I classes (8) •I classes ((2X2) • Two levels -Class instruction vs. no instruction •Initial study in spring with pretest/posttest FU1 at end of yr •FU2 study in fall •Assessed consumption of snacks -Target snacks (F & V, dairy) -Other snacks •Phone interviews with subset of parents	•SCT [108] •School-wide media program •Parental involvement in 4 classes •Mandatory one-semester health–education course in 4 classes •6 sessions/4 wks •Instructions by researchers	•Reduce salty snacks Posttest FU 1 FU2 •Increase target snacks Posttest FU1 FU2 •Decrease other snacks Posttest FU1 FU2	X	X X X X X X X	X 	•I students decreased salty snacks at post, only those with instruction maintained decrease at FU 1 •Those without classroom instruction did not increase target snacks at posttest or FU 1 •Students with classroom instruction consumed more other snacks at posttest & FU 1 •At FU 2 students with parental involvement ate fewer target foods than those without parental involvement

[a] I = Intervention; C = Control; FUs = Follow-up; PAs = Physical Activity; E = Experimental; SCT = Social Cognitive Theory [108]; K = Knowledge; As = Attitude; F = Fruit; J = Juice; V = Vegetable; FJV = Fruit, Juices, and Vegetable.

[b] Success: Yes = statistically significant (at least $p = <.0.05$) positive change in I when compared to C; No = no statistically significant positive change in I; Partial = statistically significant positive change in some aspect of I group or portion of group and identified in comment on results column.

and qualitative methods [111]. The first Dietary Guidelines for Americans [112] were released by the federal government in 1980 and it was also during the 1980s that a consensus was building for what Americans, including children over the age of 2 years, should be eating to reduce the risk of diet-related chronic diseases [113, 114].

The approach of enhancing knowledge, skills, and attitudes needed by children to understand broad food and nutrition issues and selecting a diet for general health shifted to the approach of reducing risk factors linking diet to chronic disease [86]. Behavioral interventions, derived from the field of behavioral sciences and involving the application of strategies found to be useful in other health domains, were applied to the domain of dietary intakes. In this approach educational outcomes were identified as changes in specific behaviors, such as eating patterns lower in fat or sodium, or acquisition of specific behavioral capabilities or cognitive and behavioral skills needed to enact targeted behaviors. These behavioral oriented programs were sometimes offered as part of comprehensive health education, which often targeted other behaviors, such as physical activity or smoking as well as diet.

The differences in the two approaches narrowed as nutritionists and behavioral scientists moved toward each other's positions [86]. Dietary guidelines were accepted as the basis of dietary guidance with emphasis on eating patterns or behaviors to improve health. Nutrition educators had much to gain from adding a behavioral perspective to their intervention strategies and the behaviorists had much to gain by using nutrition expertise in assessing eating behavior in a way that was meaningful to health outcomes [101]. Educators and behavioral scientists developed an increasing appreciation for the complexities and unique features of dietary change compared to other health behaviors,

and recognized that research in other health domains could not be applied to dietary change without modification.

An example of this development is White and Skinner's study [106] that used goal setting as a component of nutrition education to effect behavior change among adolescents. Students selected a specific target goal nutrient and not all students worked on every goal. This study evaluated the increase (or decrease if selected) of the targeted goal in students who selected that goal. The knowledge component for each student also focused on the goal nutrient. Substantial improvements were made consistent with goals set; significant behavior change occurred in 4 of 6 targeted nutrients.

Another example is the Great Sensations study [107] shown in Table 2. This study is from the mid-1980s and used Bandura's Social Learning Theory (SLT) [108] to design a school based intervention study that included a media campaign, classroom instruction, and a parent component in a high school setting. SLT was later renamed Social Cognitive Theory (SCT) by Bandura [108]. The study was designed to decrease students' consumption of salty snacks and increase consumption of fresh fruit snacks. The study design included an intervention and a control school. The media campaign was targeted to all students in the intervention school, and at the end of the campaign all students were choosing fewer salty snacks. However, only the students exposed to the curriculum based on behavioral learning principles maintained the practice until the end of the school year. However, 6 months later, there was no difference. This study is an example of how school-based programs began to use SCT to effectively facilitate behavior changes, even if the behavior was short-lived [108]. It also reflected a cardiovascular focus with a specific behavior targeted for change.

The move toward more behavioral-based nutrition programs began in the 1980s with health promotion initiatives [101, 113, 114]. As evidence for the diet-chronic disease connection mounted, federal moneys became available for reducing risk factors in children through school-based health promotion programs. Large multidimensional studies were planned and implemented with funding from the National Heart Lung and Blood Institute and the American Cancer Society. These initiatives coincided with the decrease in funding for NET from the original 50 cents per child to 9 cents per child in the 1980s; NET funding was eliminated in the 1990s. During the 1990s and today, USDA provides limited funds on a competitive basis for Team Nutrition grants to the states. Outcome evaluation, which was not required in NET funding, is still not required in Team Nutrition grants to states.

The large school-based nutrition education-related studies reviewed by the author reported using a behavioral focus. Because few studies that included grades 7 and 8, this review also included elementary and high school students. Most of the studies were based on social psychological theories, particularly SCT [108]. Intervention studies with a cardiovascular focus are reviewed followed by those with a fruit and vegetable focus.

Intervention studies with a cardiovascular focus

With cardiovascular disease as the leading cause of death in the Untied States, efforts to develop population-wide prevention strategies aimed at young people were initiated in the late 1970s and 1980s [115]. School-based intervention studies are summarized in Table 3 [88,116-125). School health promotion programs based on behavior change models from social psychology rather than traditional educational models were tested

Table 3. School-based nutrition education intervention studies with a cardiovascular focus. [a]

Study	Sample	Study Design	Intervention	Nutrition Education/ Intervention Targets	Success[b] Yes	No	Partial	Comments on Results
Know Your Body (KYB), Field trial KYB III Three-year impact in New York City [116,117]	•2,973 student cohort •1,209 pre-and post-follow-up data •Multiethnic •Girls and boys	•E •I schools (3) •C schools (2) •Grades 1-4 •Follow up (FU) conducted 3rd year •Dietary assessment using food frequencies •Assessment of teacher implementation of curriculum as low, moderate, or high	•SCT [108] •I curriculum -Once per week 30-40 minutes for entire year •School-wide activities •Environmental modifications •Increased fiber and decreased fat content of school lunch •C students received existing science and health curricula	•-Decreased cholesterol levels •Decreased blood pressure •Change in BMI •Increased K A •Increased self-efficacy in selecting low fat and healthy foods		X X X X X	X X	•Students in high exposure curriculum group had significantly lower total cholesterol and systolic blood pressure values than moderate or low exposure or comparison groups •Mean K greater in C
The LUNCHPOWER! Intervention Study Reducing fat and sodium in school lunch programs [118]	•16,300 students •34 schools •4 school districts •Grades 1 – 6 •Diverse geographic area •Rural 1,430 students •Suburban 3,145 students •Small city 6,845 students	•Quasi- E •All schools participated in study-no controls •Pre-posttest nutrient analysis of menus as planned and produced	•Identify and integrate lower-fat and lower-sodium recipes and products •Provide training to school lunch personnel •Provide nutrition education messages to students and parents via school lunch menu	•Monthly lunch menus to provide •mean of 22 gm or less of fat •mean of 1000 mg or less of sodium •between 550 and 750 kcal •Maintain lunch participation	X X X	X		•Significant reduction in fat and energy from fat at baseline •Sodium, lower by 100 mg from baseline, was not significantly lower than 1,136 mg at baseline •Mean energy levels decreased significantly

Table 3. (Continued)

Study	Sample	Study Design	Intervention	Nutrition Education/ Intervention Targets	Success[b] Yes	No	Partial	Comments on Results
The Stanford Adolescent Heart Health Program [119]	•-2 school districts •4 schools •Gradel10 •1447 students •69% White •13% Asian •6% Latino •2%lBlack •10% other •14%-14 y; 70%-15 y; 14%-16 y •I 45% female •C 48% female •50%lof students' fathers completed at least 4 years of college	•E •I Schools (2) •C Schools (2) •I students (622) •C students (508) •Physiologic/ anthropometric measures •Self-reported nutrition/diet •Knowledge assessment C-V risk concepts •C-V health behavior survey •Fitness testing walk/run •1130 students available at FU	•SCT [108] •Curriculum 5 modules/ 20 • sessions •Nutrition/diet •Physical activity •Cigarette smoking •Stress •Problem solving and goal setting •Recruited and trained college graduates from health-related field	•Increased K C-V risk factor concepts •Positive change in self-reported behaviors Nutrition /diet Physical activity Cigarette smoking •Changes in physiologic/anthro-pometric variables Resting heart rate BMI Systolic BP	X X X X X	 X X	 X 	•Knowledge gains were pro-nounced -Self-lreported increase in regular physical activity at FU •Reductions in body fat for males and females, but greater in females •Fewer exper-imental smokers progressed to regular smoking
Heart Smart Cardiovascular School Health Promotion [120]	•4 schools •Grades 4, 5 •530 students •58% white •32% black •10%lother\ •lower to upper-middle income families	•E •I Schools (2) •C Schools (2) •Cardiovascular screening •Self-report of school lunch •C-V health knowledge test •Fitness testing walk/run •2 ½ years	•SCT [108] •School lunch modifications •Physical education program •Health knowledge curriculum •Development of behavioral skills to •Family involvement	•Increased K •Changes in C-V factors •Heart Healthy lunch choices •Improvement in run/walk performance	X		X X X	•Children whose lunch choices werelC-V healthy had the greatest cholesterol reduction •HDL increased •Improvements in run/walk performance except 5th grade

Table 3. Continued.

Study	Sample	Study Design	Intervention	Nutrition Education/ Intervention Targets	Success[b] Yes	No	Partial	Comments on Results
Child and Adolescent Trial for Cardiovascular Health (CATCH) [121-123]	•5206 students •96 schools/CA, LA, MN, TX	•E •I schools (56) •C schools (40) •Grades 3, 4, 5 •FU	•Multilevel •SCT [108] •Organizational tional change •Physical education (PE) •School Lunch •Family •Policy •2 ½ yrs food service and PE •Curricula -3rd grade/5 wks -4th grade/12 wks -5th grade/8wks	•Reduced total fat energy and saturated fat in in school lunch •Reduced sodium content of school lunch •Reduced self-reported fat energy intake •Increased self-reported PA	X X X X			•Greater mean reduction in the % if Kcal from total fat(adjusted mean difference –4.1%, p<0.001). •Sodium was reduced in both I and C but it was significantly greater in I schools.
CATCH Follow- up (FU) [124, 125]	•3714 (73% of students in original study)	•FU grades 6, 7, 8 •FU 3 years after intervention	•None at FU	•Reduced self-reported fat energy •Increased self-reported PA	X X			•At FU energy from fat was significantly less and PA was greater in I students.

[a] I = Intervention; C = Control; FU= Follow-up; PA= Physical Activity; E = Experimental; SCT = Social Cognitive Theory [108]; K = Knowledge; A = Attitude; F = Fruit; J = Juice; V = Vegetable; FJV = Fruit, Juice, and Vegetable; BP = Blood Pressure.

[b] Suecesse Yes = statistically significant (at least p = <.0.05) positive change in I when compared to C; No = no statistically significant positive change in I; Partial = statistically significant positive change in some aspect of I group or portion of group and identified in comment on results column.

[126, 127]. An emphasis on primary prevention in children was the key element because studies were indicating that cardiovascular disease started in childhood [128, 129].

Know Your Body (KYB) was an intervention study originally developed as a comprehensive, skills–based health promotion program for K-6 grades in the 1970s by the American Health Foundation with funds from the National Institutes of Health (NIH) [116]. Developed as a comprehensive school health education program [73] KUB was designed to eliminate adopting multiple, overlapping, disease-specific curricula [116, 129]. Results of the studies indicated consistent positive intervention effects for systolic blood pressure, diastolic blood pressure, HDL-cholesterol, and health knowledge across three field trials after a three-year intervention period.

The *LUNCHPOWER!* Intervention Study [118], Table 3, was primarily a school environment intervention study that helped foodservice staff modify school lunches to lower fat and sodium. The study also provided education messages to students and parents. Training was provided school foodservice staff to lower fat and sodium in school lunches. The study successfully lowered the energy from fat in school lunches as reflected in nutrient analysis pre- and posttest. Sodium intake was also reduced but the reduction was not significant.

The Stanford Adolescent Heart Health Program (Table 3) was designed to create, implement, and test a school-based multiple risk-factor reduction program for high school students [119]. The Heart Smart cardiovascular school health promotion targeted the total school environment with a multidisciplinary approach [120]. This project implemented changes in the curriculum, the school lunch program, and physical education in two treatment schools with two comparison schools, and this study included

a cardiovascular risk factor screening component. Positive physiologic changes were observed in those students who made cardiovascular healthful choices in the school lunch menu and made improvements in run/walk performance.

The National Heart, Lung, and Blood Institute funded a large multi-dimensional field trial, the Child and Adolescent Trial for Cardiovascular Health (CATCH) in the early 1990s, to test the effectiveness of a multilevel intervention aimed at promoting a healthful school environment and positive eating and physical activity behaviors in children [121]. Three parts of that study are summarized in Table 3 [88, 121-124]. The original study was conducted over a 3-year period in 4 states, randomized to intervention or control conditions. The project was effective in changing behaviors that persisted in a 3-year follow-up study [124] of the CATCH cohort of students. The follow-up results suggested that the behavioral changes initiated during the elementary school years persisted to early adolescence for self-reported dietary and physical activity behaviors [124].

Intervention studies with a fruit and vegetable focus

While the CATCH program showed positive results in lowering fat and saturated fat intake, the promotion of a generally healthful diet, including increasing fruit and vegetable intake, to 3rd through 5th grade children was not sufficient to effect an increase in intake of fruits and vegetables as assessed at baseline and follow-up [88]. Intervention studies with a fruit and vegetable focus are shown in Table 4 [7, 87, 130-141].

There was considerable interest in the consumption of fruits and vegetables as a healthful dietary behavior for children and adults. One of the attractions to increase the

Table 4. Studies with a fruit and vegetable focus. [a]

Study	Sample	Study Design	Intervention	Nutrition Education/ Intervention Targets	Success[b] Yes	No	Partial	Comments on Results
Effects of CATCH on fruit and vegetable Intake [88]	•1186 students, a • subsample of 5106 students participated in 24-hour food recalls at baseline and at follow-up recall 3 years later	• Analysis of 24-hour food recalls at the four sites of study/CA, LA, MN, TX •Unit of analysis was fruit and vegetable consumption	•Fruit and vegetable message was part of healthy eating curricula	•Increased fruit and vegetable consumption			X	•No differences in I or C schools except at TX I site
5 a Day for Better Health National Cancer Institute (NCI) intervention 5 a Day Power Plus Program [88, 130]	•1612 students •20 schools •Grades 4 and 5 •Multiethnic •60% received free or reduced price meals	•E •I schools (10) •C schools (10) •24 hour food recalls and parent surveys on 680 •Questionnaires on all students •Collected pre- and post 1 ½ years	•SCT [108] •Behavioral curricula •16 sessions/8 wks •Parents assisted •School food service changes •Industry support and involvement •Teachers had 1 day of training	•Increased fruit (F) •Increased vegetable •Increased F and V •Increased F and V at lunchtime •Increased F and V of parents	X X	 X X X		•Higher daily consumption of fruit but not vegetables

Table 4. Continued.

Study	Sample	Study Design	Intervention	Nutrition Education/ Intervention Targets	Success[b] Yes	No	Partial	Comments on Results
5 a Day for Better Health National Cancer Institute (NCI) intervention High 5 Project: Increasing fruit and vegetable consumption of fourth-graders [131, 132, 140, 141]	•1,698 families and students •Grade 4 •28 schools •Students 51% females 82% European-Americans (EA) 16% African-Americans (AA) 2% other •Parents 90% female -medium income $40-$50,000	•E •I schools (14) •C schools (14) •Data collected •Student (S) data 24-hour diet recalls •Parent (P) data Questionnaires •S and P -Baseline data -FU at 1 year -FU at 2 years post baseline -Psychosocial scales	•SCT [108] •Multi-faceted •7 weeks •Curriculm 14 sessions/3 wks Booster session at 2 year FU •Lessons taught by curriculum coord-inators (CC) who were trained for more than 70 hrs •Teachers assisted •Food service Half-day training Reinforcement •Parents Assisted in homework 7 wk	•Increased K	X			•Increases in F & V 1.6 serving •Increase in students' intake of F&V was not observed in cafeteria •Effects of F &V while significant were less at 2 years post baseline •Increase in F &V in parents was observed only in EA parents, with male child, and married parent
				•Fruit (F) intake	X			
				•Vegetable (V) intake	X			
				• F & V at 1 year	X			
				• F & V at 2 years	X			
				in school cafeteria		X		
				•Increased parent F&V intake - 1 year post			X	
				-2 years post		X		
				• Increased K	X			
				•Changes in psychosocial measures students				
				- 1 year post	X			
				- 2 years post	X			
				•Changes in psychosocial measures parents				
				-1 year post			X	
				-2 years post		X		

Table 4. (Continued)

Study	Sample	Study Design	Intervention	Nutrition Education/ Intervention Targets	Success[b] Yes	No	Partial	Comments on Results
5 a Day for Better Health National Cancer Institute (NCI) intervention Gimme 5: An innovative, school-based nutrition intervention for high school students [133-135]	•2,213 students •12 high schools •56% female •84% Caucasian •4% African-Americans •9% Hispanic •3% Other	•E •I schools (6) •C schools (6) •Cohort followed over 3 year period from 9th grade to •12th grade •Process evaluation •Outcome evaluation •Schools were unit of analysis for all •Continuous variables •Gimme 5 measurement for 4 years •K, A and practices questionnaire •Self-report F&V •Self-efficacy scale •Awareness of *5 a Day for Better Health Campaign* [142]	•SCT [108] •Multi-component •School media marketing campaign •5 workshops for students • "Fresh Choices" fruits and vegetables in school meals, guidelines developed for food service •Parental involvement	•Increased awareness •Change in A •Increased K toward eating 5 a Day •Increased daily consumption of fruits and vegetables	X X X X			•Control group also increased in positive attitude by 3rd year. •Increase was linear for both groups over time. •C group increased intake of fruits and vegetables by third year to level in I group

Table 4. Continued.

Study	Sample	Study Design	Intervention	Nutrition Education/ Intervention Targets	Success[5] Yes	No	Partial	Comments on Results
5 a Day for Better Health National Cancer Institute (NCI) intervention Gimme 5 Fruit (F), Juice (J), and Vegetables (V) for Fun and Health [133-135]	•1,172 students •16 schools •Grades 4 & 5 •2 school districts, -4 urban -12 suburban •Random sample of parents 13-16/school for telephone interviews •85% European-American •15% African-American	•E •I schools (8) •C schools (8) •Cohort followed for 3 years •Pre/post cohort data collected •7-day food records •Psychosocial measures •FJV knowledge, preferences, and outcome expectations, self-efficacy, social norms, and asking behaviors •Classroom observations of teachers' implementation of curriculum •Grocery store education	•SCT [108] •Curriculum 2 years 12 sessions/6 wks 4th grade/ V 5th grade/F & J •1-day work shop for teachers •Parents Newsletters -Video tapes •Grocery stores Point-of-purchase education	•Increased F Yr 1 Yr 2 •Increased V Yr 1 Yr 2 •Increased FJV Yr 1 Yr 2 •Increased FJV at home •FJV K •Psychosocial measures •Fidelity to curriculum by teachers •Involvement in grocery store education		X X X X X X X X	 X X	•While there was no increase in FVJ in the 2nd year, the consumption was greater for I over C students •Statistically suggestive changes of FJV consumption during lunch at school •FJV knowledge increased in both groups but more so in I group. •Asking behaviors and social norms were the only significant positive changes in psychosocial behaviors. •Low level of fidelity to curriculum based on obsera-tions that only 22% of activities identified as crucial to achieving behavioral change were performed.

Table 4. Continued.

Study	Sample	Study Design	Intervention	Nutrition Education/ Intervention Targets	Success[b] Yes	No	Partial	Comments on Results
The California Children's 5 a Day- Power Play! Campaign: Evaluation of a large-scale social marketing initiative [138]	•3,966 students •2,684 matched cases pre/post •49 schools •3 geographically distant school communities and media markets •Ethnicity in districts varied, •Hispanic varied from 30% to over 90% •Grades 4 &5	•E •2 treatment groups -T1 – 19 schools -T2 – 1 schools -C – 15 schools •Pre- and post-assessments •24-hour self-reported food diary •Self-reported attitudinal questions •Key informant telephone surveys with adults •Observation in all classrooms and cafeterias •Observations in T1 supermarkets	•SCT [108] •Resiliency Theory [143] •T1 Power Play! Activities conducted only in school channel •T2 Power Play! Activities conducted in schools, community youth organizations, supermarkets, •Farmers' markets, mass media simultaneously •T schools -1 hr or 2 hr teacher training for implementing activities •C schools - could offer any nutrition program except Power Play!	•Self-reported changes in children's F & V consumption T1(school only) T2(school and community) •Consumption changes by eating occasion -Day time snacks and school T1(school only) T2(school and community) -Breakfast and dinner T1(school only) T2(school and community) •Self-efficacy on eating 5 a D T1(school only) T2(school and community)	X X X X X X	X X		•Both T1 and T2 reported signif-cant increases in F&V over control •The change in F&V was 7% for T1 and 14% for T2. •While not significant, a dose-response continuum was detected.

[a] I = Intervention; C = Control; FU = Follow-up; PA = Physical Activity; E = Experimental; SCT = Social Cognitive Theory [108]; K = Knowledge; A = Attitude; F = Fruit; J = Juice; V = Vegetable; FJV = Fruit, Juice, and Vegetable.

[b] Success: Yes = statistically significant (at least $p = <.0.05$) positive change in I when compared to C; No = no statistically significant positive change in I; Partial = statistically significant positive change in some aspect of I group or portion of group and identified in comment on results column.

consumption of fruit and vegetables was that by doing so, one would increase the consumption of complex carbohydrates in the form of fruit and vegetables that could displace consumption of fats and hence reduce total energy intake and improve health status [143]. Various dietary guidelines recommend increasing fruit and vegetable consumption to help decrease the risk of chronic diseases such as cardiovascular disease and certain cancers [49,145 146]; schools were urged to use the eight component comprehensive school health program to initiate a 5 a Day program [144]. Concerns about low consumption of fruits and vegetables and the possibility that healthful dietary behaviors learned during childhood might be sustained through adulthood became the basis for developing appealing and potentially cost-effective prevention efforts targeted to children [147]. The National Cancer Institute (NCI) funded 9 research projects, 4 of which were school-based [148]. The results of those four studies and others were reported in several publications as shown in Table 4 [7, 87, 130-141].

The 5 a Day intervention studies were 1½ to 3 years in duration and varied in outcomes. An increase in fruit, vegetable, or fruit and vegetable intake in four of the five projects was attributed to the availability of fruits and vegetables in the school lunch program and not away from school, even though each study included a parent component [7, 133, 136, 138]. In the study that reported the greatest increase in fruits and vegetables (1.6 servings) [141], increased intake was not observed at lunch even though there was a school lunch component.

Results varied as to whether fruits or vegetables were responsible for the increased intake [7, 136] or if both fruits and vegetables increased [133, 141] and whether the increase was sustained for a second year, or third year in one case [133]. The

Alabama High 5 project [141] and Louisiana Gimme 5 [133] sustained the increase for the second year whereas the Georgia Gimme 5 [136] did not. Researchers in the Georgia Gimme 5 study cited a low level of fidelity to curriculum in that study based on observations of classroom teachers providing the lessons. Only 22 % of activities identified as crucial to achieving behavior change were performed by the teachers. In contrast, the Alabama High 5 cited high curriculum fidelity as delivered by the curriculum coordinators.

As shown in these similar but different studies there are many aspects of a research project that can affect the study outcomes. Based on the reported 5 a Day project evaluations, an overview article suggested that process evaluations were essential and an important tool for use with health promotion programs [149]. Development of this component of research was suggested as a cost-effective alternative to relying on serial experimental tests of intervention. Several key components of process evaluation were identified for future research. While there are many factors to consider, the issue of who provides intervention components in a school setting is one of the issues.

Studies with classroom instruction and food activities

The next three studies [150-154] reviewed in Table 5 address the issue of classroom instruction and activities that promote positive food related behavior changes. The *Integrated Nutrition Education Project* (INP) studies in elementary schools focused on increasing consumption of whole grains, fruits, and vegetables. Students in treatment classrooms achieved significantly greater gains in knowledge and self-efficacy regarding food preparation and fruit and vegetable consumption [150, 151]. INP blended theories

Table 5. Studies with classroom instruction and food activities. [a]

Study	Sample	Study Design	Intervention	Nutrition Education/ Intervention Targets	Success[b] Yes	No	Partial	Comments on Results
Integrated Nutrition Education Project (INP) Outcome from a school-based nutrition education program using resource teachers and cross-disciplinary models [150]	•4 schools •851 students •Grades K-5 •Females and males •2/3 Hispanic •80% of students received free or reduced price meals	•E •Year 4 of a four project •I schools (3) •I classes (16) •I students (456) •C schools (1) •C classes (7) •C students (395) •Assessments pre- and posttest •Plate waste •Food recall/record •Student K and A survey •Teacher interviews •Process evaluation •Complete plate waste data -I 226 students -C 218 students	•SCT [108] •Piaget's Cognitive development theory [11] •Dewey's educational theories [153] •Play approach to learning [154] •Pairing of special resource teacher (SRT) with a public health nutritionist (PHN) •24 week intervention •SRT-taught classroom activities including food preparation and eating •Weekly lessons •Teachers attended inservice training •Parent and community component •School lunchroom component, fully implemented in year 4	•Increased K •Change in A self-efficacy to eat more F &V •School lunch increased F increased V increased F & V •Self-reported increase in F increase in V	X X X X X X	 X	 	•Most of the improvements seen in this study came from increased consumption of fruits. The differences between the treatment and comparison groups were partially attributed to the decline in consumption by the non-intervention groups, a finding similar to other F & V studies. [136] •Process evaluation indicated 100% implementation of the 24 lessons.

Table 5. Continued.

Study	Sample	Study Design	Intervention	Nutrition Education/ Intervention Targets	Success[b] Yes	No	Partial	Comments on Results
Integrated Nutrition Education Project Continuation of INP alternating special resource teachers (SRT) and classroom teachers [151]	•4 schools •760 students •Grades 2-4 •Females and males •90% Hispanic •80% of students received free or reduced price meals	•E •I schools (2) •I classes (19) •I students (316) •C classes (19) •C students (331) •Assessments pre- and posttest •plate waste •student K and A survey •teacher interviews •process evaluation •classroom observations •Teacher interviews •Complete plate waste data •I 310 students •C 192 students	•SCT [108] •Piaget's Cognitive development theory [11] •Dewey's educational theories [153] •Play approach to learning [154] •16 week lessons delivered bi-weekly •Classroom teacher and SRT-taught classes alternatively •activities including food preparation •Teachers attended inservice training •Parent and community component •School lunchroom component	•Increased K •Change in A toward -school lunch -whole grains -self-efficacy to eat more F &V •School lunch intake increased F increased V increased F & V	X X X X X X X			•I group ate significantly more F&V than controls. • Treatment group ate almost a full serving more compared to control students. •When compared to previous year's data, the increase in fruits was less for the I group. •Researchers speculated that a smaller increase in F & V than previous year's study [150] was due to reduced I dose, including fewer lessons, fewer taught by SRT and failure of classroom teachers to reinforce the behavioral change message.

Table 5. Continued.

Study	Sample	Study Design	Intervention	Nutrition Education/ Intervention Targets	Success[b] Yes	No	Partial	Comments on Results
The Cookshop Program: nutrition education program linking lunchroom food experiences with classroom cooking experiences [152]	•39 classes •590 students •Grades K-6	•E •Pre-post intervention- comparison 4 conditions: •11 Cookshop (CS) + food and environmental lessons (FEL) •10Cookshop only • 9 FEL • 9 Comparison •Pre/post surveys •Assess plate waste	•SCT [108] •Four conditions • (CS+FEL) - 10 CS lessons + - 10 FEL lessons •Cookshop only -10 CS lessons -10 FEL only •Components -Parent -School lunch • 13 wks	•Food preferences •Increased K •Change in A •-Self-efficacy -CS, 4-6 -all others •Behavioral intention •Less plate waste	X	X X	X	•Those exposed to the cooking lessons had significant gains in all areas except attitude •Lowest plate waste was found in those in the cooking classes and food and environment lessons.

[a] I = Intervention; C = Control; FU = Follow-up; PA = Physical Activity; E = Experimental; SCT = Social Cognitive Theory [108]; K = Knowledge; A = Attitude; F = Fruit; J = Juice; V = Vegetable; FJV = Fruit, Juice, and Vegetable.

[b] Success: Yes = statistically significant (at least $p = <.0.05$) positive change in I when compared to C; No = no statistically significant positive change in I; Partial = statistically significant positive change in some aspect of I group or portion of group and identified in comment on results column.

that incorporated the complexities of the individual/environmental inter-relationship with elements necessary for children to learn. In addition to using behavior change theory, SCT [108], Piaget's cognitive development theory [11] was translated into classroom activities through making and eating foods.

The use of special resource teachers (SRT) was selected to avoid the barriers of time pressures cited by teacher in implementing "auxiliary" curricular activities and other barriers to implementation of health education curricula facing the classroom generalist. Teachers' lack of confidence in teaching nutrition was overcome by the fact that the SRT provided all resources plus expertise in implementing the activities. Also program fidelity and instructional experience was assured through the SRT [150].

In the first INP study the use of the SRT ensured a 100% implementation rate. The researchers conducted a further study to determine the effects of having the SRT provide the nutrition education part-time with classroom teachers solely responsible for providing nutrition education in alternate weeks [151]. As in the previous study, posttest plate waste data indicated that treatment students consumed significantly more fruits and vegetables during school lunch than comparison students. However, when treatment students' consumption in the second INP study was compared to treatment students' consumption in the previous study, consumption of fruits and vegetables declined by about one-third serving. One-half of the teachers did not clearly deliver the intended nutrition messages designated by the curricula, and failure to do so might have weakened the potency of the intervention needed to change behavior [151]. Another key feature of the INP studies was the classroom experiences provided the students in preparing and tasting foods.

Another nutrition education intervention study, the *Cookshop Program* [152], linked lunchroom food experiences with classroom cooking experiences as indicated in Table 1[152]. The *Cookshop Program* [152] compared 3 classroom conditions with controls. Those students exposed to the cooking lessons with or without the food and environment lessons, had significant gains in food preferences knowledge, sell efficacy, behavioral intentions, and less plate waste.

Studies funded by USDA's Team Nutrition

Partially in response to a U.S Department of Agriculture (USDA) sponsored conference to establish priorities for future research about reinforcing healthy eating habits in the school environment [90], USDA sponsored a Team Nutrition (TN) pilot project to include environmental issues when implementing a comprehensive school-based intervention in 7 school districts [155]. The USDA pilot study is described in Table 6 [155].

TN was an educational and promotional initiative developed by USDA to change children's eating behaviors, using social marketing techniques [156]. The top research priority established at the USDA sponsored conference was the impact of the home and mealtime environments on children's eating habits. Research priorities cited as needing immediate attention included the influence of school staff and the physical environment on children's eating patterns [90].

The purpose of the TN project was to systematically document the implementation process and to evaluate whether the project resulted in healthier food choices by students [155]. Implementation included several components, including

Table 6. Studies funded by USDA' s Team Nutrition [155, 156]. [a]

Study	Sample	Study Design	Intervention	Nutrition Education/ Intervention Targets	Success[b] Yes	No	Partial	Comments on Results
Team Nutrition Pilot Study: Lessons learned from implementing a comprehensive school-based intervention [155, 156]	•7 districts in 7 states •19 schools •300 classrooms •Multiethnic minorities range from 8% to 96% •Free and reduced price meal-eligible students 31% to 85% •Grades K-4	•E •I 4th grade only •Self assessment by students •Phone interviews with parents •Pre-and post observation of student consumption in lunchroom •Outcome evaluations were conducted at 4 sites •Intervention occurred 2 times Spring/Fall with two groups of students	•SCT [108] •Multichannel nutrition interven-tion •Curriculum 12- 33 hours (average 14) •Training for -school food service staff -teachers •School wide events •Chef events •Community event •Social marketing •Media event •Parent contacts	•Increased K •Change in A •Improve self-reported eating behaviors -at project end -6 months later •Observed increase in consumption of food components in school lunch -grains/breads -low fat milk -variety -F & V	X X X X X X	 X X		•All changes were modest but significant

[a] I = Intervention; C = Control; FU = Follow-up; PA = Physical Activity; E = Experimental; SCT = Social Cognitive Theory [108]; K = Knowledge; A = Attitude; F = Fruit; J = Juice; V = Vegetable; FJV = Fruit, Juice, and Vegetable.

[b] Success: Yes = statistically significant (at least $p = <.0.05$) positive change in I when compared to C; No = no statistically significant positive change in I; Partial = statistically significant positive change in some aspect of I group or portion of group and identified in comment on results column.

training of school foodservice staff, curriculum training for teachers, age appropriate nutrition education curricula, and a variety of school-based events [156]. As determined by the process evaluation of each school, student exposure varied widely across the 7 pilot settings [155]. The reported impacts showed a modest but significant gain in students' skill-based knowledge and motivation to eat healthier. The degree of changes in self reported eating behaviors was also modest but significant at the end of intervention period, but not six months later. Small but significant increases in grain consumption, low fat milk, and diversity in grains and breads but no increases in consumption of fruits or vegetables were observed in the cafeteria [155].

Based on the information gained from the process evaluation of the TN project, the researchers suggested that if the goal of widespread institutionalization of nutrition education were to occur, choosing interventions that work and ensuring they were successfully implemented would required a support system that reduced the burden for teachers, foodservice managers and staff, and community partners [155].

Other studies conducted with adolescents including 1990s and 2000s

The number of nutrition education research studies involving middle school students in the literature was very limited. In general, little theory-based research has been conducted with adolescents [157], and much less in a school setting. Three studies are listed in Table 7 [158-162]. The first study had multiple articles covering various aspects of the Teen Eating for Energy at Schools (TEENS) Study. The second study tested the effect of a 3-day nutrition education program on calcium with adolescent females in grades 9 and 10 [161]. This limited study of short duration showed an increase in knowledge and

Table 7. Other studies conducted with adolescents during 1990s and 2000s [a]

Study	Sample	Study Design	Intervention	Nutrition Education/ Intervention Targets	Success[b] Yes	No	Partial	Comments on Results
The Teens Eating for Energy and Nutrition at School (TEENS) study [158-160]	•3800 students •16 middle junior high schools •Grade 7 & 8 •Multiethnic •Females and males	•E •I schools (8) •C schools (8) •Baseline data collection •Student surveys •Usual F & V intake •Usual food choices •Psychosocial mediators of eating behaviors change •Intervention exposure •Peer leaders	•Theory of Planned Behavior (TPB) [163] and SCT [108] •School food service component •Classroom •Family component •Curriculum -10 sessions/5 wks -Peer-leaders assisted teachers •2 years, only 1st yr results published	•Increased F by exposure - Peer leader group -Curriculum -Environment only •Increased V - Peer leader group -Curriculum -Environment only •Increased F & V Peer leader group Curriculum Environment only •Change in Psycho-social mediators	X X X X X X X X			•Students exposed to curriculum had borderline statistical increase (p =0.056) in F & V •Environment and control had no increase
Changes in nutrition knowledge scores and calcium intake in female adolescents [161]	•49 female adolescents •Grades 9 and 10 •Majority were Caucasian	•E •I students (20) •C students (20)	•3-day nutrition education program on calcium •Taught by Home Economics researcher •PE classes •Pretest, posttest, post-posttest	•Increased K (calcium and vitamin D) •Behavioral change (Calcium and vitamin D intake)	X	X		•Knowledge was retained 1 month post-posttest •Both groups increased in calcium and vitamin D but there was no significant difference between groups

Table 7. Continued.

Study	Sample	Study Design	Intervention	Nutrition Education/ Intervention Targets	Success[b] Yes	No	Partial	Comments on Results
Live! Eat Less Fat and More Fiber. Chronic disease risk reduction curriculum for young adolescents in middle schools [162]	•5 schools •448 students •Grades 6, 7, 8 •147 white and 164 non-white (mostly Black) students •Racial make-up by schools varied •177 females and 164 males •Average age 13.1	•E •I schools (4) •I students (266) •C schools (1) •C students (75) •Pre and post-assessments •341 matched pre-posttests	•Used "Process of Nutrition Education" model [164] •6 week curriculum with 5 units was based on 5 instructional strategies and 8 behavioral change factors •1-day training for food and consumer science teachers	•Composite gain scores by site •Increased K -Goal setting -Diet and disease -Food Guide Pyramid -Nutrition labels -Low fat eating •Nutrition A -Low fat eating -High fiber eating	 X 	 X 	 X X X X X X	•Results varied by school site -Yes only 2 -Yes only 2 -Yes 3 sites -Yes only 2 -Yes only I -Yes only 2 •Race, based on ANOVA results, accounted for within-treatment variations

[a] I = Intervention; C = Control; FU = Follow-up; PA = Physical Activity; E = Experimental; SCT = Social Cognitive Theory [108]; K = Knowledge; A = Attitude; F = Fruit; J = Juice; V = Vegetable; FJV = Fruit, Juice, and Vegetable.

[b] Success: Yes = statistically significant (at least $p = <.0.05$) positive change in I when compared to C; No = no statistically significant positive change in I; Partial = statistically significant positive change in some aspect of I group or portion of group and identified in comment on results column.

increased intakes of calcium and vitamin D in the intervention group and the control group. The study design was weak in that both intervention and control students were in the same school. The third study was based on a middle school curriculum called *Live!* (Eat Less Fat and More Fiber) [162].

In the TEENS study, school and student recruitment were considered the two most challenging issues, followed by maximizing student exposure to the classroom curriculum and to implementation of the curriculum [160]. The TEENS researchers recommended working closely with classroom teachers in designing activities that are effective. Family and Consumer Science teachers were used in the TEENS study. Family and Consumer Science teachers may not exist in all schools and in some schools these teacher may not reach all students. Therefore, one would need to determine the appropriate teachers, such as health or science teachers, to work with in designing and implementing an intervention to obtain maximum student exposure or change requirements so all students received the exposure. Process evaluations are recommended by researchers to help determine the levels of compatibility, fidelity, dose and participation of the intervention as implemented [88, 151, 158, 164].

The Family and Consumer Science curriculum *Live!* was implemented and evaluated in 5 middle schools in one school district [162]. Only one school was used as a control school. Based on the study results, some aspects of the curriculum were more positive in schools with higher percentages of non-white students, who were mostly Black students. Any conclusions about the program's effectiveness, when compared to the one control school with a lower percentage of Black students, may have been biased. Also in describing the project, no mention was made of the fidelity to the curriculum or

any other components of a process evaluation that might have explained the varying study results.

Study using computer based interactive multi media game

A school-based nutrition education intervention called *Squires Quest* is reported in Table 8 [166]. This study applied evolving ways to engage children in learning. The target audience was upper elementary grade children and involved an innovative use of a multimedia game used on a computer. *Squires Quest* was created and tested by a research group that had been engaged in previous large, multi-component, 5 a Day dietary change research efforts. With this study, the group achieved what other studies could not, except for one [141]. There was a significant increase in fruits, juice, and vegetables of one serving difference between pre- and post- intervention. One of the possible reasons for the success of the program was that behavior messages were delivered as intended because they were built into the game. The game was highly interactive and took into account the student's own eating practices and encouraged the eating of fruits and vegetables as part of the response to the game. The basis for success of this project is an interdisciplinary innovation called psychoeducational multimedia technologies (PEMTs) [167].

Studies focusing on consumption of dairy products among adolescents

While the number of published nutrition education interventions was limited, there were studies focusing on consumption of dairy products among adolescents. One school-based

Table 8. Study using computer based interactive multimedia game. [a]

Study	Sample	Study Design	Intervention	Nutrition Education/ Intervention Targets	Success[b] Yes	No	Partial	Comments on Results
Squire's Quest! Dietary outcome evaluation of a multimedia game [166]	•26 schools •1,578 students •Grade 4 •Schools matched on size and % of students receiving free and reduced price meals randomly assigned to condition •Mixed ethnic •52% female	•E •Simple two-group design •I schools (13) •C schools (13) •Baseline assessment 2 wks •Interactive multimedia 4 day dietary assessment simulating a multi-pass 24-hour dietary recall •Intervention 5 wks •Post-assessment 2 wks •Implemented in 2 waves, 1 wave per semester	•SCT [108] •Computer-based interactive multimedia education •10 sessions, 25 minutes per session/ 5 wks	•Increased F •Increased J •Increased V	X X X			•Intervention resulted in a 1 serving difference of FJV between I and C schools •The change in FJV was 2nd largest in the literature with High 5 [140] showing a 1.6 gain in FJV. •Gain attributed to multimedia game and control of delivery of content as designed.

[a] I = Intervention; C = Control; FU = Follow-up; PA = Physical Activity; E = Experimental; SCT = Social Cognitive Theory [108]; K = Knowledge; A = Attitude; F = Fruit; J = Juice; V = Vegetable; FJV = Fruit, Juice, and Vegetable.

[b] Success: Yes = statistically significant (at least $p = <.0.05$) positive change in I when compared to C; No = no statistically significant positive change in I; Partial = statistically significant positive change in some aspect of I group or portion of group and identified in comment on results column.

study involving over 32,000 students identified the sociodemographic, personal, psychosocial, and behavioral correlates of low consumption of dairy products among adolescents in grades 7 through 12 [168]. Factors related to low consumption of dairy foods included being female, nonwhite, and of low socioeconomic status. Psychosocial factors associated with low consumption of dairy foods intake included low weight satisfaction and lower school grades, C or below. Dieting was significantly associated with low dairy intake. Based on these findings, the researchers concluded that interventions aimed at increasing consumption of calcium-rich foods among this age group should focus on high-risk groups [168].

Research has documented the decreasing consumption of milk as children enter early adolescence and there has been considerable discussion about why this might be occurring [28, 40, 42, 69, 169-180]. However, little research has been published to indicate effective ways to counter this trend through school-based interventions. In a 10-multistate project funded by USDA, focus groups were conducted with Asian, Hispanic, and white preadolescents and adolescents to gain a perspective on their intake of calcium-rich foods [171]. Based on focus group data, references for beverages other than milk were evident; motivators and barriers to consumption of dairy foods were identified. From information obtained from this project, additional research was planned to develop calcium intake interventions that would appeal to adolescents.

Two calcium and dairy oriented curricula have recently been developed for the middle school age adolescent [181, 182]. These are presented here for information and not in the Tables 1-8, as they do not have intervention effects documented in the literature. A Web-based curriculum for middle school children was developed for access

through the World Wide Web [181], but its effects on adolescents' food-related behavior have not been reported. Called *Clueless in the Mall*, the curriculum was developed and tested with children aged 11 to 15 years. The developers stated that the Web site should be viewed as a component, not the sole activity, of a calcium education program aimed at increasing calcium intakes of teenagers.

Another curriculum "Jump Start Your Bones" was developed through formative research as a school-based osteoporosis prevention curriculum for middle school students [182]. It is promoted as a comprehensive, multi-disciplinary osteoporosis prevention curriculum that can be utilized by school nurses, school teachers, extension educators, and other health professionals. The intended target audience is middle school students receiving classroom education. However no published research has documented the curriculum's effect on food-related behavior. (Personal communication with Kathleen Shimomura, Rutgers Cooperative Extension, Flemington, NJ, February 23, 2003.)

Summary of effective school-based nutrition education programs

There has been a steady progression of school-based education research studies ranging from a focus on the attainment of knowledge, attitude, and skills to focusing on specific behavioral changes, including food selections. Researchers are suggesting that interventions to promote healthy adolescent behaviors are most likely to succeed if multiple intervention components, grounded in a theoretical framework, are used [159]. However, these same researchers are acknowledging that it is difficult to disentangle the effects of multiple intervention components.

Two intervention studies of adolescent students [107, 160] and one of elementary students [152] failed to show positive changes in eating behaviors if the only interventions were environmental, such as choices in school foodservice program or snacks. Curriculum intervention along with changes in the food preparation and menu items offered in school foodservice showed positive changes in several multi-component studies [7, 118, 120, 121, 133, 136, 138, 150, 151, 155, 166]. The question "Can changes be sustained over time?" is more difficult to answer, but the CATCH study indicated that students did retain the practice of lower fat consumption behavior in a 3-year cohort follow-up [88].

How to measure the implementation of school health curricula has become an area of research [183] due to findings that inadequate teacher implementation can reduce or eliminate any impact of an intervention program. Examples include the KYB studies, the Georgia Gimme 5 study, and the second INP project [116, 136, 151]. Studies designed to avoid teacher implementation issues have been successful as shown by the Alabama High 5 that increased the consumption of fruits and vegetables by delivery of the curriculum by trained coordinators [132, 149].

Other factors identified as important for successful interventions was the use of process evaluations as part of the study in addition to outcome evaluations. Process evaluation assessed factors that affected or reflected how the intervention was conducted and received [149]. Process evaluations helped researchers understand how the components of an intervention interrelated and how the mediators related to outcomes. Based on this knowledge, an improved design of all components was possible which could lead to an improved outcome. Several of the large multi-component school-based

projects reviewed for inclusion in this review have published useful articles based on the design and implementation of the projects and could be used by others planning similar research [116, 132, 135, 156].

Another useful article for designing effective nutrition education interventions was that of recruitment issues in school-based research and the lessons learned from the High 5 Alabama project [131]. Their suggested recruitment strategies for future school-based interventions studies included enlistment of a district advocate, meeting with teachers to solicit support, using incentives with students and teachers, making direct contact with parents, having teachers keep rosters of students returning consent forms, and tailoring recruitment strategies for specific subpopulations.

Other issues that need to be addressed in nutrition education intervention studies include the duration of the interventions and the use of preliminary studies to ensure that measures can be devised and tested that will be able to detect any changes in consumption, given the duration and power of the intervention. Another consideration is the use of evaluation instruments that are appropriate for the intervention objectives and for the intended audience [8]. Baranowski, Lin, Wetter, Resnicow and Hearn stated that although important lessons have been learned from the community and school intervention trials "the positive outcomes in school intervention trials have been weak in comparison to the resources involved, including substantial funding, multiple years of intervention, large samples, use of state-of-the art theory, sophisticated statistical models, and the expertise of leading health promotion researchers," (page S89) [8]. They suggested that health promotion researchers should focus more on understanding underlying mechanisms and demonstrating that they can affect these mechanisms before

developing treatment programs. Baranowski, Lin, Wetter, Resnicow and Hearn proposed the use of a mediating variable model. This would ensure that mediating relationships between variables would be understood as they impact on behavioral outcomes.

In addressing the correlates of inadequate consumption of dairy product among adolescents, it has been suggested that it is the responsibility of educators and health professionals to identify the factors that motivate youths to consume a healthful diet, to identify groups of adolescents at high risk for poor eating patterns, and to address relevant issues in a manner most likely to reach those at higher risk for inadequate intake [168]. Based on the concerns about inadequate calcium intake by middle school students, this study was planned to test a coordinated intervention to improve middle school children's calcium intake.

PURPOSE OF STUDY

Based on the concerns about inadequate calcium intake by middle school students, the major purpose of this intervention study was to increase calcium intake of children in middle schools. A secondary purpose was to describe middle school children's perceived satisfaction with their school foodservice program pre- and post-intervention. Strengths and weaknesses of the methodology used in the study were evaluated. A third purpose was to understand the school eating environment in middle schools by determining foods and beverages available to children during the lunch period. The intervention was planned to involve both classroom and cafeteria experiences of children in grades 6-8 in selected schools in South Carolina.

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Part 2

Calcium Intake and Breakfast Patterns of Middle School Children

ABSTRACT

Objective The major purpose of this study was to increase the calcium intake of children in selected South Carolina middle schools.

Design A pretest/posttest randomized intervention/control group design was implemented.

Subjects/setting Ten intervention and 10 control schools participated. Students from selected classes in grades 6-8 completed pre- (n = 1034) and post- (n = 1049) 24-hour food recalls.

Intervention Teachers and foodservice managers in intervention schools were provided training and supplemental materials that focused on potentially increasing calcium intake for children in grades 6, 7, and 8. Control schools did not receive training or supplemental materials about calcium.

Main outcome measures Based on the 24-hour food recalls, calcium intakes were determined for intervention vs. control groups, pre- and post-intervention, by gender, grade level, breakfast or no breakfast consumption, and race.

Statistical analyses performed Statistical analyses included group means, univariate analysis of variance (UNIANOVA), chi-square tests, Tukey HSD, and Pearson correlations.

Results There were no differences in mean calcium intakes between the pre- and posttest results in either intervention or control school students. The posttest mean calcium intake was 719 mg in intervention and 666 mg in control schools. These intakes were considerably below the recommended Adequate Intake (AI) of 1300 mg. Males

consumed significantly more calcium than females ($p< 0.001$), and this difference persisted after controlling for males' greater energy intakes ($p< 0.01$). However, males' mean calcium intake was only 64.1% and females' intake 47.5% of the AI. Students who ate breakfast had a significantly higher mean intake of calcium than students who had no breakfast (789 mg vs. 487 mg calcium, ($p<0.05$). The correlations between mean daily calcium intakes and racial group were positive for white females, negative for black females but not significantly related for males.

Applications While the intervention was not successful in changing patterns of calcium intake, intakes below recommendations by both males and females were documented. Males had a significantly higher daily intake of calcium than females, however both groups were well below the recommended AI of 1300 mg. Strategies for increasing calcium consumption for all adolescents in the middle school setting are needed, including classroom and school foodservice settings. Because 28% of these middle school students skipped breakfast and breakfast consumption was positively related to calcium intake, strategies for increasing breakfast consumption should be explored.

INTRODUCTION

Calcium intake is important to the development of peak bone mass (PBM) [1, 2], especially in the years just before and during the peak growth velocity of adolescence (ages 10-13 for girls and 12-15 for boys) [3]. Adequate calcium consumption is considered a primary prevention strategy for osteoporosis [4], however, studies indicate that low intakes of calcium coincide with the periods of rapid skeletal growth and may limit the amount of calcium deposited in skeletal tissue [1, 4-8]. A major factor

contributing to calcium inadequacies in adolescents is their low intake of milk and other dairy foods [9, 10].

Among blacks and other minorities, low consumption of dairy products was related to lactose intolerance, or lactose maldigestion [11]. However, recent studies indicate that maldigesters can consume small amounts of milk at each meal (a cup or less) and suffer no effects [12]. Avoidance of dairy products by weight conscious individuals is common because dairy products are often viewed as high in fat [2, 13], and in a study of adolescents in grades 7-12, dieting was significantly associated with lower intake of dairy foods [14]. However, recent studies on the effects of dietary calcium, in both animal and human subjects, indicated that dairy calcium contributed to a lower fat mass and greater weight loss than calorie restriction alone [15-19]. Also a diet that included low-fat dairy products lowered blood pressure in susceptible minorities [20], including 14-16 year old adolescents [21].

Strategies to address the calcium intake gap in middle schools

There has not been a published report of a comprehensive or coordinated approach addressing calcium intake in a school environment. Two recent nutrition education curricula developed specifically for middle school aged children cover general nutrition concerns [22, 23], and other Web-based curricula and materials have been developed for this age group to address the need for and sources of calcium [24, 25] but not as a stand-alone curricula.

In a study by Harel, Riggs, White, and Menzies, 9th grade adolescents were aware of the main benefits of calcium, but they lacked specific information about daily

requirements and calcium content of the various dietary sources [26]. Several U.S. government agencies and national organizations [27-31] have developed strategies to address the gap between calcium needs and calcium intakes, deemed "the calcium crisis in America" [8]. A social marketing campaign to promote calcium intake among youth [27, 28] was designed for females and their mothers. The dairy industry developed marketing campaigns aimed at both males and females [32] to promote milk consumption and sponsored national calcium summits to promote awareness of strategies to "reach and teach youth" [30,31], including promoting participation in school meal programs, especially school breakfast [33].

Students who consume school meals under the National School Lunch Program (NSLP) and the School Breakfast Program (SBP) are more likely to meet the recommended dietary intakes, including those for calcium, than students who do not participate in the programs [34-40]. Milk is a required component of school meals and must be provided and/or offered for all meals served under the NSLP and SBP regulations [41].

Strategies for conducting school-based nutrition education

School nutrition services, including school meal programs, have been identified as an essential component of coordinated school health programs [42-44]. School-based interventions addressing factors of behavior change and school environmental change have been suggested as strategies that complement and build upon each other [43, 45], particularly with adolescents [23, 46, 47]. Minnesota researchers conducted a peer-led nutrition education program for young adolescents that incorporated classroom and

school foodservice strategies that produced a significant increase in fruit and vegetable consumption for the peer leaders [47]. Additional information about nutrition education intervention effects in school settings is provided in Part 2 of this dissertation.

Purpose of study

The major purpose of the study was to increase the calcium intake in selected South Carolina middle school children in grades 6-8 through a multiple channel approach using the classroom, the NSLP, the SBP, and a classroom intervention component with a specific focus on calcium. The purpose of using a comprehensive approach was not to determine the most effective channel or means of increasing calcium intake, but to provide an environment that supported an increase in calcium consumption through strategies that appealed to middle school children with varying sociocultural needs and learning styles. In addition to determining calcium intakes by intervention vs. control school students, effects of gender, grade level, breakfast consumption patterns, and racial groups were explored. Breakfast consumption was a special focus because the percentage of school breakfasts served in South Carolina middle schools was 19% vs. 24% of the state average for all breakfasts served in South Carolina schools.

METHODS

Research design and overview

This study used a pretest-posttest randomized group design with 10 intervention and 10 control schools. All schools were enrolled in both the NSLP and SBP and were selected from the total number of middle schools (n = 163) in South Carolina that included 6^{th}, 7^{th}, and 8^{th} grades. Schools were stratified on the basis of student enrollment and

participation in the SBP. Approval for the study was obtained from the Institutional Review Board of the University of Tennessee and from officials in the selected school districts.

Dietary intake data were collected with 24-hour food recalls from students who had parental permission to participate in the study. Pre- and post- intervention data were collected from mid-February to late-May 2002 in designated classrooms (at least one class per grade) in the 10 intervention schools and at similar time periods in the 10 control schools.

Pre- and post- intervention data collection

The 24-hour food recalls, coded by student number and school, were administered by the researcher in a classroom setting and reflected a weekday. Food models were used to assist students in estimating portion sizes of foods eaten. Containers of school milks, fruit juices, and common-sized beverage containers were displayed to assist in estimating fluid ounces of beverages. Because school menus and portion sizes were known, students were prompted to indicate serving portions eaten for those foods consumed at school.

Student breakfast consumption data, pre and post- intervention, was based on the 24-hour food recalls and with each student classified into one of three categories — breakfast (not at school), school breakfast, or no breakfast. Breakfast was categorized as any food or energy containing beverage, including sweets or soft drinks, consumed before 10 AM [48].

Intervention objective and strategies

Teachers from the intervention schools were provided with a general nutrition education curricula [22, 23] for middle school students and additional supplemental materials about sources of calcium [25, 27, 28, 49], including interactive Web-based sites [24, 32, 50]. This was reinforced in the intervention school meal programs by offering additional calcium-rich foods in school menus. A description of the classroom and school foodservice intervention and an analysis of the intervention are further described and discussed in Part 4 of this dissertation.

Data analyses

The 24-hour food recalls were analyzed for energy and nutrient content (Nutritionist Pro™ 1.2, First DataBank, San Bruno, CA). As a crosscheck, a sample number of the recalls, completed by each of the two nutritionists entering the data, were reentered by the other nutritionist to verify the accuracy of the data coding. Congruence between the coders was 94% for calcium, the nutrient of primary interest in this study.

Potential changes in mean calcium consumption of the intervention vs. control groups were determined using univariate analysis of variance (UNIANOVA) (SPSS 11, Chicago, IL). The percentages of mean daily calcium intakes were compared to the Adequate Intake (AI) [51]. To determine gender differences in calcium intakes, UNIANOVA was repeated with the control and intervention groups combined and with missing gender data (25 students pretest and 58 posttest) excluded. Because energy intake patterns for males differed from that of females, mg calcium per 1000 kcal were compared between males and females, using UNIANVOA. Another UNIANOVA was

performed with mg calcium as the dependent variable and gender, grade level, and gender and grade interaction as independent variables.

The number and percentage of students reporting breakfast or no breakfast consumption by control and intervention schools, pretest and posttest were compared. Breakfast consumption patterns and daily calcium intakes were explored with UNIANOVA. There were no significant differences in calcium intake or breakfast patterns between intervention and control students pre- or posttest, therefore the posttest data were combined for further analyses. Gender and grade level differences in breakfast participation were determined using chi-square tests. The relationship between calcium intake and breakfast consumption, pre- and posttest, was explored with UNIANOVA to test differences. The mean daily calcium differences between the three categories of breakfast consumption – breakfast (not at school), school breakfast, or no breakfast – were compared by Tukey HSD to identify where significant differences occurred.

Because participants were not asked to report racial data, percentages of racial composition in each of the 20 schools studied were used to test the relationship between race and calcium intake. The relationships between calcium intake by racial makeup of the school and by gender were determined using Pearson correlations.

RESULTS

Calcium intake

The mean intakes of calcium, pre-intervention, for students from intervention (n = 553) and control (n = 438) schools, were 772 mg $\pm$ 24 SE and 773 mg $\pm$ 22 SE, respectively. Post-intervention, the mean intakes of calcium were 719 mg for the intervention group

and 666 mg calcium for the control group (Table 1). No significant differences in calcium intakes between students in the intervention and control schools were found either pre-or post-intervention. Mean intakes of calcium were considerably below the recommended AI of 1300 mg calcium for both males and females [51].

Table 1 shows the mean calcium intakes by gender and by grade. There was a significant effect between calcium intakes and gender ($p<0.001$) but not by grade. When energy intake was controlled, mean calcium intake for males, posttest, was 430 mg/1000 kcal (SE $\pm$ 10.8) compared to 357 mg/1000 kcal (SE $\pm$ 8.3) for females. While not significantly different, mean daily calcium intakes of females decreased from 680 mg/day in grade 6 to 556 mg/day in grade 8 (data not shown). This decline reflects the decline in energy intake by females from grade 6 to 8. The percentages of Adequate Intake (AI) [51] in the combined posttest for both genders were well below the recommended 1300 mg, with the average mean AI for males at 64.1% and for females, 47.9%.

Breakfast consumption patterns and calcium intake

Table 2 indicates the number and percentages of students reporting breakfast or no breakfast consumption; there were no significant differences between control and intervention groups. Most breakfasts were eaten at home, and 71% of the children ate breakfast on the survey day. Further analyses of students' breakfast consumption patterns pretest vs. posttest showed that the breakfast skipping was not necessarily a consistent pattern. Only 53 % of those who skipped breakfast at pretest also skipped it at posttest. For those who ate school breakfast on the pretest day, 62% also ate school breakfast on the posttest day.

Table 1. Post-intervention mean daily calcium [a] intakes of South Carolina middle school students combined, by intervention/control groups, gender, and grade.

Group, Gender, and Grade		Students	Calcium Intake	Std. Error [b]	AI [c]
		n [d]	mg		%
Combined group, intervention/control [e]		990	696	± 15.4	53.5
	Intervention	553	719	± 21.2	55.3
	Control	438	666	± 23.9	51.2
Males	Combined	359	816**	± 28.5	64.1
	Intervention	206	862	± 42.4	66.3
	Control	153	793	± 49.2	61.0
Females	Combined	631	618**	± 19.5	47.5
	Intervention	346	634	± 21.8	48.7
	Control	285	598	± 24.0	46.0
Males	6th	101	774	± 53.8	59.5
	7th	122	839	± 46.3	64.5
	8th	136	834	± 45.7	64.2
Females	6th	177	680	± 37.6	52.3
	7th	214	619	± 35.2	47.6
	8th	240	556	± 34.8	42.8

**Difference in mean calcium intake between males and females was significant at <0.001 as determined by univariate analysis of variance (UNIANOVA) (SPSS 11, Chicago, IL).

[a] Data from posttest 24-hour food recalls in 10 intervention and 10 control schools.

[b] Standard error of the means.

[c] Adequate intake for calcium was established at 1300 mg for both males and females.[51]

[d] n = number of students in each subset.

[e] Total number of posttest recalls was 1049; gender was missing on 58.

Table 2. Students reporting breakfast or no breakfast [a] by intervention/control groups, pretest/posttest, and by posttest gender in South Carolina middle school study.

Treatment	Breakfast (Not at school)	School Breakfast	No Breakfast	Total
Pretest	**n[c] (%)**	**n[c] (%)**	**n[c] (%)**	**n**
Intervention	324 (58%)	74 (13%)	160 (29%)	558
Control	251 (55%)	63 (14%)	141 (31%)	455
Totals	575 (57%)	137 (14%)	301 (30%)	1013
Posttest				
Intervention	306 (57%)	85 (16%)	142 (27%)	533
Control	225 (51%)	83 (19%)	135 (30%)	443
Totals	531 (54%)	168 (17%)	277 (28%)	976
Posttest [d]				
Males	203 (56%)	71 (20%)	88 (24%)	362
Females	328 (53%)	97 (16%)	189 (31%)	614
Totals	531 (54%)	168 (17%)	277 (28%)	976

[a] Breakfast was defined as eating or drinking anything before 10 AM that contributed energy [48].
[b] Data from posttest 24-hour food recalls in 10 intervention and 10 control schools.
[c] n = number of students in subset, % of total sample in subset.
[d] Combined intervention and control school students.

There were no significant differences in breakfast consumption among the three grade levels or between males and females; however, 31% of the females skipped breakfast on the posttest day compared to 24% of the males (Table 2). There was no significant difference between mean calcium intakes of those who consumed breakfast away from school or at school.

The mean daily calcium intakes of students who did not eat breakfast were significantly lower ($p< 0.05$) than the mean calcium intakes of students eating breakfast, either away from school or at school (Figure 1). On the average, students eating breakfast had about 300 mg more calcium daily than students eating no breakfast.

Racial makeup of schools and calcium intakes

The mean calcium intakes by gender and by school for combined pre- and post- 24-hour food recalls are shown in Table 3. The 20 schools were listed in order of the percentages of student racial makeup of the schools, beginning with the lowest to the highest percentages of black students (and the highest to the lowest percentages of white students).

The correlation between mean daily calcium intakes and racial group was positive for white females ($r = 0.070$, $p=0.012$), negative for black females ($r = -0.067$, $p=0.016$) but not statistically significant for white males ($r = 0.056$, $p=0.120$) or for black males ($r = -.068$, $p=0.061$). However, all correlations were relatively weak.

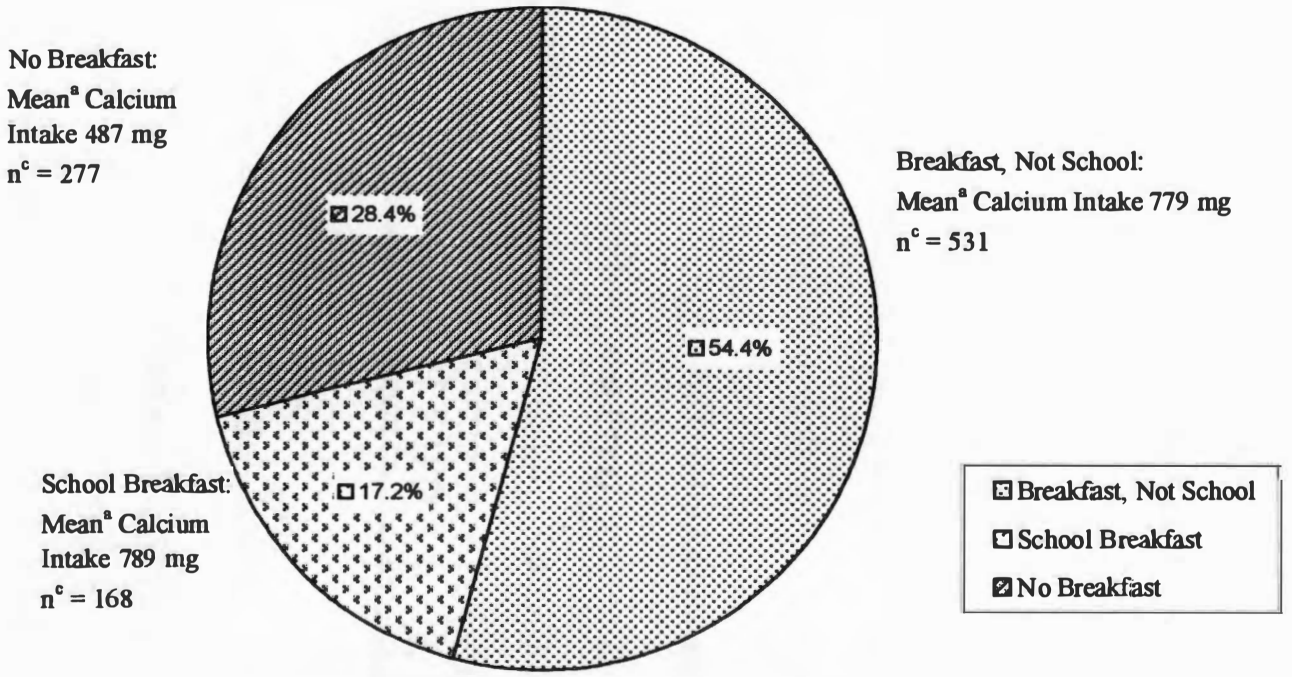

Figure 1. Breakfast Consumption of Students in Grades 6-8 in South Carolina Calcium Study[a,b]

[a] Mean calcium intake based on nutrient analyses of 24-hour food recalls

[b] Number of middle school students = 976 in 20 schools, 10 intervention and 10 control

[c] n = number of students in category

Table 3. Mean calcium intake [a] by racial makeup and by gender in 20 South Carolina middle schools.[b]

School	Black	White	Other	Total Students [b]	Mean Ca Intake [a]	Male Students [b]	Mean Ca Intake [a]	Female Students [b]	Mean Ca Intake [a]
	%	%	%	n	mg	n	mg	n	mg
1	.06	99.4	0.0	92	878	52	979	40	745
2	2.3	97.4	0.3	176	623	39	761	137	584
3	4.8	94.2	1.0	91	952	37	1159	54	810
4	6.9	90.1	3.0	178	618	76	642	105	600
5	11.2	87.7	1.1	71	942	32	1096	39	815
6	22.6	63.9	13.5	58	775	16	1182	42	619
7	31.9	59.9	8.2	127	638	56	834	72	485
8	37.5	52.5	10.0	78	801	19	1040	59	724
9	37.6	59.3	3.1	135	786	39	844	96	762
10	41.6	57.7	0.7	127	684	45	737	82	654

Table 3. Continued.

School	Black	White	Other	Total Students [b]	Mean Ca Intake [a]	Male Students [b]	Mean Ca Intake [a]	Female Students [b]	Mean Ca Intake [a]
	%	%	n	mg	n	mg	n	mg	%
11	43.7	52.7	3.7	66	771	22	906	44	696
12	53.2	45.4	1.3	96	875	37	1170	59	690
13	53.6	45.1	1.2	82	619	30	562	52	650
14	59.3	38.4	2.3	75	757	25	1096	50	588
15	61.6	33.0	5.4	65	791	25	1027	40	644
16	62.0	30.1	7.8	135	740	51	975	84	596
17	70.1	27.4	2.5	105	895	43	979	62	837
18	75.3	23.9	0.8	112	595	49	673	63	534
19	83.1	16.9	0.0	95	672	47	708	48	638
20	84.3	14.9	0.9	88	576	26	649	62	545

[a] Mean calcium intake based on analyses of 24-hour food recalls.
[b] 6th, 7th , and 8th grade students in selected South Carolina middle schools

DISCUSSION

Calcium intakes

Both males and females in this study had lower calcium intakes than the recommended 1300 mg AI [51]. There was no increase in calcium intake post-intervention. Males had a significantly higher mean intake of calcium than females; however, their mean intake was only 64.1% of the AI, and females' mean intake was 47.5% of the AI. National studies conducted in the mid-1990's found girls aged 9-13 years had a mean daily calcium intake of 889 mg, and those aged 14-18 years consumed an average of 713 mg [9]. The girls in South Carolina, ranging in ages from 11-15 years, consumed a daily average of 618 mg calcium. While these ages do not coincide exactly with those in the national database collected 8 years earlier, participants in this study had mean intakes about 100 mg less than reported in earlier studies among older girls. This may reflect the temporal trend documented in food consumption studies that show soft drink consumption of adolescents is increasing while milk consumption is declining [10, 52-55].

Compounding this problem of low calcium intakes by the South Carolina students may be "offer versus serve" provisions allowed by federal school lunch and breakfast regulations [41]. Under this provision, students in the 20 schools may refuse up to 2 of the 5 required items on the school lunch menu and 1 of the 4 required items on the school breakfast menu. Thus, students selecting a school breakfast could select juice offered as a vegetable/fruit component and decline the milk. The situation is different at lunch because most of the schools in this study offered alternative beverages for sale. Students may refuse the milk that was part of the meal and purchase an alternate beverage.

The lack of increase in calcium intake post-intervention may have been influenced by the short duration of the study and the emphasis that teachers and other school personnel placed on the intervention strategies, including instructional, foodservice, and multi-channels used. Research of this type involves issues that aren't subject to the investigator's control, e.g., teachers' time devoted to the intervention and use of calcium related resources, food service staffs' compliance with menu changes, inventory controls, school administrators' scheduling, and schools' food and beverage sales that may be at cross purposes with the intervention. These constraints may have influenced the results.

Intervention strategies focused on individual behavioral change such as goal setting [56] or on an interactive method that controlled delivery of the nutrition message relative to the individual [57] have produced positive changes in student dietary behavior. Studies with adolescents that incorporated classroom and school foodservice strategies produced significant increases in fruit and vegetable consumption in selected students [47]. School nutrition environment changes along with classroom interventions could reinforce and support individual dietary behaviors leading to increased calcium intake.

Breakfast consumers (males and females combined) had higher mean calcium intakes than breakfast skippers (60% vs. 37% AI). The tendency for females to skip breakfast more frequently than males has been reported [34, 35, 51, 55]. The percentages of South Carolina students not eating breakfast (24% males, 31% females) is similar to another study that showed 22-35% of youth skipping breakfast [58]. In national studies, children who ate breakfast had significantly higher intakes of milk [9, 34, 35, 37-40, 59, 60]. This finding was particularly noticeable among children in low-income households who ate a school breakfast compared with children who did not eat breakfast [55].

The lower calcium intakes in this study than in national studies may be related to the relatively high percentage of black students in the South Carolina schools (41.4%). In national studies, black males and females consumed fewer dairy products and had lower intakes of calcium [61]. The weak relationships between race and calcium intake in this study may reflect the analyses by school rather than by individual because the racial distributions of the sample may or may not reflect that in these schools.

A school-based study of over 32,000 students identified the correlates of low consumption of dairy products among adolescents in grades 7 through 12. The risk factors were being female, nonwhite, and low socioeconomic status [14]. Calcium intakes between non-Hispanic whites and non-Hispanic blacks were compared for several age groups based on 24-hour food recalls recorded in the second National Health and Nutrition Examination [61]. The mean daily calcium intake for white males was 1,332 mg, compared to 887 mg for blacks. White females mean daily calcium intake in the same age group was 842 mg compared to black females with 700 mg.

APPLICATIONS

- While the intervention was not successful in changing patterns of calcium intake, intakes below recommendations by both males and females were documented.
- Effective strategies for increasing calcium consumption by all adolescents in the middle school grades 6-7 are needed, including classroom and school foodservice settings.

- Classroom interventions focusing on individual student behavior and using instructional methods such as goal setting may be needed to increase consumption of calcium-rich foods.
- A supportive school environment that promotes the consumption of calcium-rich food items in school foodservice and restricts access to alternative beverages to milk in school meals could reinforce classroom interventions and individual behavior changes.

- Because 28% of the middle school students skipped breakfast and breakfast was related to higher calcium intakes, strategies for increasing breakfast consumption should be studied, including greater student participation in the School Breakfast Program.

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Part 3

Factors Influencing Foodservice Satisfaction in Middle School Children

ABSTRACT

Objective The purpose of this study was to describe middle school children's perceived satisfaction with their school foodservice program pre- and post-intervention as part of a classroom and school foodservice study focused on increasing dietary calcium intake. Sub-objectives were to determine if satisfaction was related to students' perception of having a choice in school meal participation and to identify the foodservice-related factors that predicted satisfaction.

Design A pretest/posttest randomized group design was used with 10 intervention and 10 control schools. Schools were randomly selected based on enrollment and current participation in the school breakfast program from a larger pool of 163 South Carolina middle schools with grades 6-8.

Subjects/setting Students in selected classrooms from grades 6-8 in each school completed the validated school foodservice satisfaction survey (SFSS) before and after the intervention.

Intervention School foodservice managers, district foodservice directors, and selected classroom teachers at the intervention schools were provided in-service training about the study goals, information about the importance of calcium intake by middle school children, and strategies to increase children's calcium intake.

Main outcome measures Pre/post-intervention responses of students to the SFSS were determined. SFSS scores of students who perceived they had a choice or no choice in eating school meals were compared. Survey variables relating to students overall satisfaction with school foodservice were determined.

Statistical analyses performed Pre/post-intervention scores of students were computed based on a 7 point hedonic scale with 1 = lowest and 7 = highest score. Pre- and post-intervention responses to the SFSS were compared using UNIANOVA. General linear models (GLM) were used to test differences between intervention/control students' SFSS scores in overall satisfaction (question 1 on the SFSS) and the 5 factors contributing to overall satisfaction – food quality, staff, ambience, price and time. Because there were no differences in SFSS scores in students who had taken both the pre/post surveys, for both intervention/control groups, these matched pairs of students were combined for further analysis. To test if students' scores who perceived they had a choice vs. no choice in eating school meals were different, a stepwise regression analysis of the responses to 25 questions was performed with the dependent variable of overall satisfaction to determine which survey questions contributed significantly to overall student satisfaction.

Results The survey sample included 980 students pretest, 936 posttest, and 744 to 807 pre/posttest matched pairs. There were no significant differences in SFSS mean scores from pretest to posttest. There were no differences between the groups of students who took both the pre- and posttests and these students were treated as matched pairs for further analyses. Students who perceived they had a choice vs. those with no choice had significantly higher scores on overall foodservice satisfaction ($p<0.05$) and all five satisfaction factors ($p<0.001$ - $p<0.05$). Seven of the 25 questions measured by the SFSS predicted over 53% of the variance in overall foodservice satisfaction with the students who felt they had a choice($p<0.001$).

Applications/conclusions Student food service satisfaction did not change from pre- to post-intervention. The moderate scores indicate room for improvement. For students who

perceived they had a choice in eating school meals, satisfaction with school foodservice was related to food quality including choices and foods liked by students as well as appearance of the food. Foodservice staff smiling and greeting students was also an important factor in students' satisfaction with school foodservice. Staff may play an important role in providing food choices that appeal to middle school students and ensure the school meal programs provide adolescents the nutrients they need.

INTRODUCTION

All South Carolina public schools participate in the National School Lunch Program (NSLP) and the School Breakfast Program (SBP). In school year (SY) 2000-2001, 67% of students participated in the NSLP and 24% in the SBP, with students eligible for free and reduced price meals participating at higher rates. Participation in the school lunch program varied by category of nonpaying or paying status; 83 % of students eligible for free meals, 76% of students eligible for reduced priced meals, and 51% of students who paid full price for meals participated daily [1]. These percentages are similar to national data.

A nationally representative study, the School Nutrition Dietary Assessment Study-II, reported that 60 % of all students in public schools participated in the program during SY 1998-99 with students approved to receive free meals participating at a higher rate (80%) than students approved for reduced-price meals (69%) or students paying full price (48%) [2]. Analyses of meals served in SY 1998-99 indicated school meals met more than one-third of the 1989 Recommended Dietary Allowances (RDA) [3] with the

exception of lower energy intake than recommended for secondary school students [2]. These data are consistent with goals of the NSLP [4].

However, accessibility to school meal programs alone does not ensure that children choose to participate in the reimbursable school meal programs or that the programs meet students' perceived needs [5-7]. The nutrition environment at school and the availability of foods and beverages other than school meals influence participation as well as other factors [8]. Research studies have shown that prices charged for lunch, the variety of foods offered, the quality, taste, cleanliness, temperature of hot food, and time available for eating have been factors in student participation [9-11]. In a study of high school students, satisfaction with school foodservice was influenced by whether or not students believed they had a choice of eating school lunch, the variety of food offered, and the flavors of food served [12]. Similarly in middle school/junior high school students, differences in satisfaction were found between those who never ate, ate 1-3 times per week, and those that ate 4-5 times per week [13]. Satisfaction was also related to participation factors associated with food quality, price, and staff.

The purpose of the study was to describe the relationship between South Carolina middle school students' perceived satisfaction with their school foodservice program, and to determine if that satisfaction changed after a foodservice and classroom intervention approach that focused on increasing dietary calcium intake. Also examined was student satisfaction related to students' perception of having a "choice" in school meal participation and SFSS variables that predicted overall satisfaction among students who perceived they had a choice in participating in school meals.

METHODS

Subjects/setting

A pretest-posttest randomized group design with 10 intervention and 10 control schools was used in the study. Schools were randomly selected on the basis of school size, average daily membership (ADM), and participation rates in the SBP. Each group of 10 schools included 2 schools with ADM between 198 to 799 and with SBP participation at or below the state average of 19% for middle schools, 3 schools with ADM between 198 to 799 with SBP participation above 19%, 4 schools with 800 to 1300 ADM with participation 19% or below, and 1 school with 800 - 1300 ADM with SBP participation higher than 19%.

Students in selected classrooms from grades 6, 7, and 8 in each school (at least 1 class per grade in each school) completed SFSS forms. The researcher collected data, pre- and posttest, from mid-February to late-May 2002 during a regularly scheduled classroom period. Each student was provided a number code to enter on the survey form for tracking pre- and posttest responses and to enable analyses based on matched pairs of students. Approval was obtained from the Institutional Review Board of the University of Tennessee and from officials in the selected South Carolina school districts.

Survey instruments

The Applied Research Division of the National Food Service Management Institute (NFSMI) developed and validated instruments to measure foodservice satisfaction among various school age groups [13]. NSFMI is a research and education center established by the U.S. Congress and administered by the U.S. Department of Agriculture, Food and

Nutrition Service. A School Foodservice Satisfaction Survey (SFSS) for middle/junior high school students was developed in conjunction with an initial pilot that used a high school foodservice survey [10, 13]. The NFSMI used factor analysis to reduce the number of questions from 50 to 26 and to identify major constructs for further analysis. One question "How happy are you with the school foodservice overall?" was removed from the factor analysis and was used as a dependent variable to develop the constructs. The 5 foodservice factors and reliability coefficients (alpha level) were food quality (.9208), staff (.8383), time (.8224), price (.8130), and ambience (.7748) [13]. The 26-item middle school version also included 8 additional student variable questions to determine students' perceptions of why they ate school breakfast and school lunch, the number of times per week they ate school breakfast, school lunch, or brought their lunch, their grade in school, gender, and approximate age. Students' perception of choice in eating school lunch was measured by the question, "The number one reason I eat school lunch is?" Two of the choices to this question were "My parents make me" and " I have no other choice." If a student chose either 1 of these 2 responses they were classified as having "no choice. Responses to any of the other 7 choices were classified as students having a "choice" [5, 13]. SFSS computer scan forms were purchased from the NFSMI [13]

In-service training

Following pretest assessments the researcher provided in-service training to school foodservice managers, food service directors, and selected teachers at intervention schools (Appendix C). The training included the study goals, information about the importance of calcium intake in middle school children, and strategies to increase

calcium intake [15, 16]. The suggested strategies included encouraging increased participation in school meals and snacks including expanding school breakfast [17] and increasing the offerings of calcium-rich foods in school meals.

Analyses

Statistical analyses were conducted using SPSS 11 (SPSS, Chicago, IL, 2001). Means of the student responses to the 26 survey questions were determined for intervention and control groups. Scoring was based on a 7 point hedonic scale with 1 = lowest satisfaction, 7 = highest. Mean SFSS pretest scores of intervention and control groups were compared using univariate analysis of variance (UNIANOVA) and found to differ significantly ($p<0.001$). Because participation in pretest and posttest groups differed for both intervention and control groups, scores of students who did not complete both a pretest and a posttest were excluded for further analyses. These matched pairs were further analyzed using general linear models (GLM) to determine differences between intervention/control students' SFSS scores in overall satisfaction (question 1 on the SFSS) and the 5 factors contributing to overall satisfaction – food quality, staff, ambience, price, and time.

Based on previous studies [5, 13, 14] and using matched pair scores, analyses of SFSS scores for overall satisfaction and the 5 factors were analyzed to determine if students who perceived they had a "choice" in eating school meals were different from those who perceived they had "no choice." Stepwise multiple regression analyses of students who perceived they a had a "choice," using overall satisfaction as the dependent

variable and the 25 remaining survey questions as independent variables, were applied to determine factors predictive of student satisfaction.

To determine the effect that non-matched SFSS scores might have had on study results, UNIANOVA was performed to compare those students who missed either the pretest or posttest with the matched pairs. Pre-intervention scores of the matched pairs were compared with scores of the students who missed the posttest survey and the matched pair post-intervention scores were compared with the students who only completed the posttest survey.

RESULTS

Sample

The survey sample included 980 students pretest and 936 posttest from at least 60 selected classrooms with at least one class from each grade per school in the 10 intervention schools and 10 control schools. Thirty-six percent of the participants were male and 64% were female. The percentages of students in the sample from the three grade levels were 6^{th} grade, 28%; 7^{th} grade, 34%; and 8^{th} grade, 38%. There were 701 to 736 matched pair responses on overall satisfaction (question 1) and the 5 factors contributing to satisfaction.

SFSS student pretest/posttest scores in intervention/control schools

There were no significant changes in mean scores from pretest to posttest as a result of the intervention (Table 1). Mean scores indicated only moderate satisfaction with school

Table 1. SFSS [13] mean scores [a] (± SE) by pretest/posttest, intervention/control, and matched pairs of South Carolina middle school students.

Category		Intervention		Control		Effects of intervention for matched pairs [b]	
		n [c]		n [c]		F Score	Sig. [f]
Overall Satisfaction	**Pre-**	516	4.28 ± 0.06 SE	409	3.80 ± 0.07 SE		
	Post-	509	4.34 ± 0.09 SE	387	3.92 ± 0.09 SE		
Matched	**Pairs**	395	4.20 ± 0.09 SE	288	3.72 ± 0.11 SE		
		395	4.34 ± 0.09 SE	288	3.85 ± 0.10 SE	.000	.997
Staff	**Pre-**	547	4.85 ± 0.06 SE	433	4.71 ± 0.08 SE		
	Post-	528	4.71 ± 0.07 SE	408	4.63 ± 0.08 SE		
Matched	**Pairs**	420	4.89 ± 0.09 SE	319	4.70 ± 0.09 SE		
		420	4.70 ± 0.09 SE	319	4.63 ± 0.10 SE	1.110	.293
Ambience	**Pre-**	547	4.63 ± 0.05 SE	433	4.40 ± 0.02 SE		
	Post-	528	4.56 ± 0.06 SE	407	4.30 ± 0.07 SE		
Matched	**Pairs**	421	4.59 ± 0.07 SE	319	4.37 ± 0.07 SE		
		421	4.54 ± 0.07 SE	319	4.30 ± 0.08 SE	.019	.889
Price	**Pre-**	532	4.38 ± 0.06 SE	420	4.06 ± 0.07 SE		
	Post-	515	4.43 ± 0.090 SE	392	4.03 ± 0.10 SE		
Matched	**Pairs**	403	4.26 ± 0.10 SE	302	3.90 ± 0.11 SE		
		403	4.19 ± 0.10 SE	302	3.92 ± 0.11 SE	.481	.488

Table 1. Continued.

Category		Intervention		Control		Effects of intervention for matched pairs [b]	
		n [c]		n [e]			
Food Quality	**Pre-**	547	4.11 ± 0.05 SE	433	3.87 ± 0.03 SE		
	Post-	529	4.08 ± 0.06 SE	407	3.74 ± 0.07 SE		
Matched	**Pairs**	421	4.03 ± 0.71 SE	319	3.78 ± 0.08 SE		
		421	4.04 ± 0.07 SE	319	3.72 ± 0.08 SE	.850	.357
Time	**Pre-**	543	3.62 ± 0.07 SE	430	3.50 ± 0.10 SE		
	Post-	527	3.64 ± 0.09 SE	404	3.35 ± 0.10 SE		
Matched	**Pairs**	416	3.50 ± 0.11 SE	314	3.42 ± 0.12 SE		
		416	3.60 ± 0.10 SE	314	3.29 ± 0.11 SE	2.368	.124

[a] Question 1 was overall satisfaction (1 question only) followed by 25 questions pertaining to 5 categories, staff (4 questions: numbers 4, 7, 13, and 16), ambience (6 questions: numbers 8-12 and 15), price (2 questions: numbers 5 and 17), food quality (11 questions: numbers 2, 3, 6, 14, 18, 19, 20, 22, 23, 25, and 26), and time (2 questions: numbers 21 and 24). See APPENDIX E for the 26 questions.

[b] Controlling for pretest scores, posttest scores of intervention vs. control groups were tested by GLM, SPSS 11 [SPSS, Chicago IL, 2001]

[c] 10 intervention and 10 control middle schools in South Carolina with students in grades 6, 7, and 8.

[d] Scale 1 = low or least satisfied, 7 = high or most satisfied.

[e] n= number of students responding to the category of SFSS [13] questions. The number of students responding to each question varied from 928 to 980 pretest and from 896 to 936 posttest. Analyses of effects are based on matched pairs. The number of matched pairs responding to the categories varied from 701 to 736.

[f] posttest mean for matched pairs

foodservice. The factor mean scores, ranked from the highest to lowest, were similar for both intervention and control students with the staff factor being highest and the time factor, lowest. Contributing to the higher scores for the staff factor in both intervention and control groups were students' responses to 2 of 4 questions "Servers and cashiers are polite" (5.09 $\pm$ 1.93 SD, intervention, 5.06 $\pm$ 2.07 SD, control), and "Servers and cashiers treat me with respect" (5.01 $\pm$ 1.90 SD, intervention and 4.95 $\pm$ 2.00, control). Mean posttest responses to each of the 26 questions are provided in Appendix E.

Effects of students' perceptions of choice vs. no choice in school meal participation

Posttest SFSS scores of students who perceived they had a choice in school meals (i.e. intervention and control groups) were combined for additional analysis, and mean scores are shown in Table 2. Those who perceived a choice in eating school meals, compared to those who did not, had higher scores ($p<0.001$) on overall foodservice satisfaction and higher scores on the five factors contributing to overall satisfaction – foodservice staff ($p<0.001$), ambience ($p<0.001$), price ($p<0.05$), food quality ($p<0.001$), and time ($p<0.001$).

Variables predicting satisfaction

Table 3 shows the results of regression analyses that predicted the variables contributing to overall school foodservice satisfaction of students who perceived they had a "choice" in school meal participation. The model with 7 questions ($p<0.001$) accounted for 53% of the variance, and 5 of the 7 questions related to food quality, 1 to staff, and 1 to price.

Table 2. Effect of choice in school meal participation on students' SFSS [a] [13] mean factor scores. [b]

Category	Mean Score [c]	F Score d[c]	Significance
Overall Satisfaction [e]			
No Choice (n = 258) [f]	3.67		
Choice (n = 486)	4.39	8.71	<0.001
Food Quality			
No Choice (n = 283)	3.32		
Choice (n = 525)	4.23	38.32	<0.001
Staff			
No Choice (n = 283)	4.32		
Choice (n = 524)	4.88	6.90	<0.01
Ambience			
No Choice (n = 283)	4.08		
Choice (n = 525)	4.64	11.50	<0.001
Price			
No Choice (n = 283)	3.78		
Choice (n = 524)	4.34	4.58	<0.05
Time			
No Choice (n = 283)	3.05		
Choice (n = 524)	3.73	16.90	<0.001

[a] School Foodservice Satisfaction Survey
[b] Posttest scores of intervention and control groups, combined.
[c] Scale 1 = low or least satisfied, 7 = high or most satisfied.
[d] UNIANOVA SPSS 11 [SPSS, Chicago IL, 2001] (Pairwise comparison and univariate tests)
[e] One question.
[f] Number of students in sample, intervention and control students combined.

Table 3. Variables predicting satisfaction with school foodservice for middle school students [a] who perceived they have a choice in school meal participation. [b]

Independent variables [b]	F [c]	R^2	Sig.	ß value
1. I like the choices of food offered.	355.0	.347	<0.001	.158
2. The school menu includes foods I like.	252.4	.431	<0.001	.193
3. Servers and cashiers smile and greet me when I am served.	197.7	.471	<0.001	.153
4. Main dishes on the serving line (such as spaghetti or chicken) look good.	168.2	.503	<0.001	.158
5. I like how the food looks.	141.6	.516	<0.001	.142
6. I like the quality of the brands offered.	121.9	.521	<0.001	.118
7. School foodservice prices are OK for what I get.	107.0	.526	<0.001	.092

[a] N = 486 students from sample middle schools who perceived they had a "choice".
[b] Multiple regression with dependent variable satisfaction. Dependent variable: "Overall, I am happy with the school foodservice." Scale 1 = low or least satisfied, 7 = High or most satisfied.
[c] Entering F score.

Pre/post-intervention scores of matched pairs with students missing pre-or post-SFSS

There was a significant interaction ($p<0.05$) between the pre-intervention scores of the matched pairs (n = 744) and those who missed taking the posttest (n = 181). Those who did not take the posttest scored higher on the pretest than did the students who did both. The average pretest mean score for the matched pairs was 3.99 ($\pm$ 0.07 SE) and 4.35 ($\pm$ 0.14 SE) for the students with missing posttest scores. However, no difference was found between the posttest scores of the matched pairs and the 152 students who missed the pretest and only took the posttest (mean scores, 4.13 $\pm$ 0.07 SE and 4.21 $\pm$ 0.15 SE, respectively).

DISCUSSION

With the exception of the NFSMI surveys [5, 10, 13, 14], there have been few recent studies on student satisfaction with school meal programs [6, 9, 11,12]. The findings in this study of South Carolina middle schools were consistent with findings in a high school survey concerning variety of food, food quality, foodservice staff, aesthetics of the serving and dining area, and demographics [12]. In the Fogleman study overall foodservice satisfaction was highly correlated with variety of food offered, flavor of food, attractiveness of food on the serving line, staff smiling and greeting students, quality of food choices, choices that allow students to meet cultural and ethnic preferences, courteousness of the staff, and quality of ingredients. The best predictor of satisfaction was the variety of food offered [12].

In a study with middle school students Meyer used an instrument adopted for the younger age group [5, 13, 14]. The variable "choice" was included in the independent variables of a stepwise regression to test whether having a choice to eat school lunch predicted satisfaction. Analysis of variance was conducted to determine if differences existed between the groups had a "choice" vs. "no choice." Three variables explained 39.1% of the variance – school menu including foods students like, quality of the food choices, and prices are okay for what students get.

The NFSMI analyzed SFSS from 138 middle/junior high schools in 14 states (1999-2000) [14]. The national mean scores from over 30,000 students in overall satisfaction and the 5 foodservice factors were overall satisfaction (3.77 $\pm$ 1.69 SD), staff (4.13 $\pm$ 1.74 SD), ambiance (4.07 $\pm$ 1.42 SD), price (3.48 $\pm$ 1.88 SD), food quality (3.35 $\pm$ 1.43 SD), and time (3.15 $\pm$ 1.95 SD) were compared to the South Carolina study. South Carolina scores, both intervention and control, pre- and posttest, exceeded the national mean scores. Despite this, the South Carolina SFSS scores were moderate pre-and post-intervention compared to potential lowest or highest scores.

It may have been unrealistic to expect a change in foodservice satisfaction as a result of this study. According to Meyer when a school conducts two SFSS during the same school year, as in this study, the mean scores decrease later in the school year. (Personal communication with Mary Kay Meyer, NFSMI, University MS, March 2002.)

The national data, as did the South Carolina data, showed a significant difference for overall satisfaction ($p<0.001$) between scores of students who thought they had a choice and those who did not [5, 13, 14]. According to Meyer, regarding SFSS findings of various grade levels [14], one common denominator in making students feel they had a

choice in school meal participation was the staff. In the South Carolina study, 2 of the highest scoring questions were related to staff factors, "Servers and cashiers treat me with respect" and "Servers and cashiers are polite." Meyer suggested that by focusing on how students are treated, students are more satisfied with the school foodservice program [14].

Researchers [15,16] have suggested segmenting the adolescent population based on gender or motivational factors influencing food choices and then tailoring nutrition interventions and education messages to these specific segments. School foodservice staff may play an important role in implementing strategies to appeal to middle school students to make nutritional choices and to ensure the school meal programs provide adolescents the nutrients they need during an important growth period and help them adopt healthy eating habits.

Study limitations

The number of participants was less than the potential sample and it is not known how the non-participants would have responded. A weakness was the short duration of the study, particularly at the end of the school year. The opportunity for making changes that would shift student satisfaction scores was limited.

APPLICATIONS AND CONCLUSIONS

- The South Carolina students' SFSS scores on overall foodservice satisfaction and the 5 factors affecting satisfaction were moderate and indicate there is room for improvement in school foodservice programs in South Carolina.
- Seven variables measured by the SFSS predicted 53 % of the variance in overall foodservice satisfaction for students who felt they had a "choice." This included 5

variables related to food choices and quality, 1 to staff, and 1 to school meal prices. School foodservice staffs could influence students' perceptions that students have a choice by increasing/adapting the foods and services they offer.

- School foodservice staffs may play an important role in providing quality foods at reasonable prices, providing choices in school meals, and relating to students such as in smiling and greeting students.

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Part 4

Evaluation of an Intervention Study to Increase Calcium Intake and Foodservice Satisfaction in Middle School Children

ABSTRACT

Objective To evaluate the strengths and weaknesses of the methodology used in an unsuccessful school-based calcium intake intervention study designed to increase children's calcium intake and increase their satisfaction with school foodservices.

Design A review of the methodology used in a pretest-posttest randomized intervention/control group design study.

Subjects/setting A randomly stratified sample of 20 schools selected from the total number of schools (n=163) in South Carolina that included grades 6-8.

Intervention Teachers and foodservice managers in intervention schools were provided with training, curricula, and supplemental materials focused on increasing calcium intake by middle school children.

Main outcome measures Strengths and weaknesses of the methods used.

Results While 20 schools, 44 teachers, and approximately 1000 students were successfully recruited, and pre- and posttest data were successfully obtained and analyzed, there were no significant changes in calcium intake or foodservice satisfaction following the intervention. Strengths of the study included the research design, successful recruitment of schools, and participation of the researcher in pre- and post-data collection and data analysis of 24-hour food recalls. While part of the research study had strengths, the intervention component of this study was not effective, based on the results. The major weaknesses of the study included the lack of a formal process evaluation of the classroom or cafeteria intervention, no pilot testing of intervention materials or strategies with South Carolina students, and a compressed timeline due to initiating the study

during the last 4 months of the school year resulting in a short duration for the intervention.

Applications/conclusions Conducting research in middle schools is feasible; however, adequate planning is essential, and careful monitoring of interventions at the individual student, classroom, and school level is required. A greater emphasis on the individual child and how calcium intake affects them and what the child should do about it may support a calcium intake intervention. School foodservice staffs could influence students' perceptions that students have a choice by increasing/adapting the services and foods offered, including calcium-rich foods, and providing quality foods at reasonable prices.

INTRODUCTION

A study of 4 months duration was conducted in selected South Carolina middle schools to test a multi-component intervention program to improve middle school children's calcium intake. The intervention was planned to involve both classroom and cafeteria experiences of children and to describe their perceived satisfaction with their school foodservice program pre-and post-intervention. The intervention was not successful in improving children's calcium intake and the study did not show changes in students' school foodservice satisfaction. These parts of the study are described in greater detail in parts 2 and 3 respectively in this dissertation. Another component of the study was successful and is described in part 6 in this dissertation.

This study is not unique in its inability to change dietary behaviors [1]. Relatively few school-based studies have shown positive results when the aim was changing food-related behavior [2-5]. Little theory-based research has been conducted with adolescents

[6], and few published research studies involved middle school students [7]. This paper evaluates the methodology used in the study of South Carolina middle school children. The intent is to identify strengths and weaknesses of the study for use in the development of future school-based interventions related to calcium.

METHODS

Research design and overview

The study was a pretest-posttest randomized group design with intervention and control groups. The stratified sample of 20 middle schools (10 intervention and 10 control) was selected from the 163 middle schools that incorporated grades 5-8 exclusively from the 208 schools that housed any of the middle school grades. All schools in South Carolina participate in both the School Breakfast Program (SBP) and National School Lunch Programs (NSLP). Stratification was based on school breakfast participation percentages and student enrollment. The sample size was deemed a priori to address the initial research question to intervene and increase calcium intake of students in these schools.

This study included pre- and posttesting of children's food intake (using 24-hour food recalls) in selected 6^{th}, 7^{th}, and 8^{th} grade classes. Perceived satisfaction with the foodservice was measured with the school foodservice satisfaction survey (SFSS) purchased from the National Food Service Management Institute. Intervention in the classroom and in the cafeteria (intervention schools only) focused on increasing calcium intake post-intervention.

Recruitment

School superintendents were contacted to obtain permission to invite school principals to participate in the study. Once permission was granted, principals were contacted and teachers and students were recruited. If permission was declined, the next school on the stratified list was contacted.

Based on recommendations from the school principals, a teacher at each grade level was invited to take a lead in participating in the study for their grade level. One class per grade per teacher was selected as the school's study group for the pre- and posttesting.

The teacher was responsible for sending letters provided by the researcher to parents or guardians explaining the project and requesting their written consent. Based on guidelines of the Institutional Review Board (IRB) at the University of Tennessee (UT), students were not allowed to participate in the data collection phase of the project without parental permission. Some teachers initiated the use of incentives to reward students for returning the permission forms; others did not.

Subjects/setting

To allow for differences in participation rates in the SBP and sizes of schools, a computer generated random stratified sample of 20 schools was drawn (SPSS 11, Chicago IL). Within both the intervention and control schools, 5 schools were to be small schools with memberships less than 800 students (2 with less than the middle school state average of 19% school breakfast participation and 3 with 19% or greater participation). Five were to

be large schools with memberships of 800 students or larger (4 schools with less than 19% breakfast participation and 1 school with 19% or greater participation).

Intervention objectives and strategies

The overall objective of the study was to increase calcium intake by using a social marketing approach to appeal to all middle school children but also subgroups of middle school children prone to breakfast skipping. The intervention objectives developed for school foodservice and selected classrooms follow.

- School foodservice objective
    - To increase the availability of calcium-rich foods offered in the school meal programs.
    - To increase students' perceived foodservice satisfaction.
- Objectives for selected classrooms
    - To promote teacher awareness of the importance of calcium intake by middle school children through in-service training, resources, and instructional materials.
    - To promote student awareness of the importance of calcium intake and dietary sources of calcium, and to encourage consumption of calcium-rich foods through providing age-appropriate and gender-specific educational and promotional materials to participating classrooms.
    - To increase student interest in calcium and nutrition in an interactive format by providing teachers with age-appropriate, gender-specific Web-based sites and activities designed for promoting calcium intake.

School foodservice directors, cafeteria managers, and participating teachers from the intervention schools were provided in-service training relevant to the intervention goals and objectives. A one-day meeting was conducted to encourage food service personnel to promote an increased use of calcium-rich foods in menu items other than the required school meals' offering of milk. Other strategies discussed for increasing calcium-rich foods in school food service was the possibilities of expanding the SBP. Foodservice strategies would be applied school-wide and not just to the sample of intervention students. The school foodservice component of the intervention was not monitored.

Teachers were provided with a general nutrition education curricula for middle school students [8, 9], supplemented with specific information about calcium-rich foods and nutrient needs during early adolescence. Milk as a major source of calcium and information on what constitutes a serving were also emphasized along with results of focus groups of pre-teen girls that identified taste, convenience, and peer influence as motivators for dairy consumption [10]. Materials for students included a Web site on calcium for teens, developed and tested with children aged 11 to 15 years [9], and calcium-related promotional materials targeted to 9-12 year old girls, including a Website and calendar [12]. Boys were provided with Got Milk? ™ skateboard key chains. *Calcium? Are You Getting Enough?* brochures [13] were provided for all students in the respective teachers' classes. Teachers were provided copies of a CD-ROM with nutrition education game-like modules [14]. In-service training for the intervention group teachers was scheduled in computer labs to familiarize the teachers with the Web sites and computer-based materials.

During the post-data collection phase an informal review of teachers' use of materials and teachers' comments on student reactions were solicited. Information from teachers was voluntary, and no records were maintained of contact hours with the materials or student responses to the materials. Teachers' use of materials was not monitored. Calcium intake was not discussed in the control schools at either the foodservice or classroom level by the researcher. At the end of the study, the calcium-related materials provided to intervention schools, including those targeted to students, were provided to teachers and students in the control schools.

Pre- and post-intervention data collection

Data, 24-hour food recalls and SFSS, were collected from mid-February to late-May 2002, pre- and post-intervention, in classrooms in the selected schools during a regularly scheduled class period. The food recalls were collected on a midweek day so that they would reflect a weekday rather than a weekend or holiday. The researcher, a trained professional with a nutrition background, gave directions about recording foods eaten in the previous 24 hours on a coded form (Appendix A). Food models and representative containers were used by the researcher to enhance reporting accuracy.

Data analyses

All pre- and post-food recalls collected at the school level were screened by the researcher prior to coding and entrey into a nutrient analysis database (Nutritionist Pro™ 1.2, First DataBank, San Bruno, CA). Trained nutrition personnel were used to code and enter the dietary data. To improve the accuracy of the nutrient analysis, recipes and nutrient analyses from manufacturers supplying food products used by the school food

service programs were entered into the database. The SFSS data, collected on optical scanning forms, were submitted to the NFSMI for reading and placement into a data file. Data generated from the 24-hour food recalls and the SFSS were imported into the project database at the University of Tennessee.

Evaluation of intervention at student level

The evaluations of the intervention at the student level (6^{th}, 7^{th}, and 8^{th} grades) were based on the primary and secondary objectives for individual students in the selected classrooms. The primary objective was to determine if students in the selected classrooms changed consumption of calcium-rich foods from dairy and other sources following the intervention end, and the secondary objective was to determine if foodservice satisfaction increased after the intervention. Individual scores were aggregated to determine group mean scores.

RESULTS

Time frame

Funding for this study was awarded in late December 2001, and the IRB granted approval in January 2002. Recruitment of schools and teachers began in late January and continued until early March. Baseline data collection began in February and continued until late March. Interventions ranged from 3 to 6 weeks at various sites. Post-intervention data were collected from mid-April to late-May. Data analyses were completed in the fall of 2002. The following sections describe the results of the various components of the study methodology.

Recruitment

A combination of on-site visits or phone calls to school principals or other designated staff to explain the project was initiated to recruit schools depending on the district's protocol. All school principals contacted by the researcher, except one, agreed to participate. When superintendents referred the decision to intermediate district staff, e.g., secondary school administrators responsible for multiple schools rather than one as were school principals, participation was usually declined. Six of eleven districts that declined to participate were larger districts with over 30 schools.

Twenty schools were successfully recruited from 15 school districts in varying parts of the state, both rural and urban. A state map showing locations of study sites is in Appendix D. Eleven school districts declined participation for one or more schools selected from the random list. The recruitment results matched the initial design.

Principals chose the teachers to participate in the study based on their judgment of how the intervention would fit with the subjects taught by the teachers. Science teachers were most frequently selected followed by Health and Physical Education teachers. In those schools that had a Family and Consumer Science teacher, the principals chose that teacher providing they had classes composed of both genders, a requirement of the study. This choice was made because food and nutrition-related components were featured in their curricula. In those schools that offered this subject, the course was required of all students for at least one nine-week session.

The number of teachers in each school varied from one to three, based upon the school principal's designation. Table 1 shows the subjects taught by teachers in the intervention and control schools. In schools where fewer than three teachers were

Table 1. Subjects taught by teachers in intervention/control schools.

Subject Taught	Intervention School Teachers	Control School Teachers	Total Teachers
	n [a]	n [a]	n [a]
Science	5	14	19
Health and Physical Education	7	4	11
Family and Consumer Sciences	3	4	7
Social Studies	1	2	3
Math	2	0	2
Other	2	0	2
Totals	20	24	44

[a] n = number of teachers

involved, the designated teachers tended to teach either Health and Physical Education (n=10 of 11) or Family and Consumer Science (n=6 of 7). In schools (n=10) with 3 teachers each, most were science teachers (n=19) but included Social Studies, Math, and other subjects.

Subjects/setting

The number of students participating in the project by school, intervention, and grade level posttest are shown in Table 2. While the number of students originally projected per classroom was 30 students (1800 total), most classes had fewer than 30 students. A total of 1076 students participated in the 24-hour food recalls and SFSS posttest. Table 2 shows the total numbers of students per grade by intervention/control groups who completed the 24-hour food recalls. The three grade levels were fairly evenly distributed with 33% in the 6th grade, 32% in the 7th grade, and 35% in the 8th grade. Thirty-six percent of the participants were males and 64% were females. Students completed both food recalls and the SFSS but the actual numbers of useable data from SFSS were lower. The percentages of students in the SFSS sample from the 3 grade levels were 28% in the 6th grade, 34% in the 7th grade, and 38% in the 8th grade.

The actual number of students varied by site and by the number of returned parental permission forms. Some students were absent during either the pre- or posttest data collection. The number of students who did not return parental permission forms was not known, as teachers were not asked to report these data to the researcher.

Table 2. Number of students participating in posttest 24-hour food recalls by school, intervention/control, and grade.

School	I = Intervention C = Control	6th Grade Students	7th Grade Students	8th Grade Students	Total Students
1	I	17	14	18	49
2	I	15	15	15	45
3	I	18	21	6	45
4	I	25	19	16	60
5	I	27	30	30	87
6	I	26	17	20	63
7	I	27	19	28	74
8	I	22	18	26	66
9	I	10	21	13	44
10	I	22	18	30	70
11	C	14	13	11	38
12	C	6	9	12	27
13	C	21	17	19	57
14	C	23	32	35	90
15	C	18	13	14	45
16	C	4	13	14	31
17	C	12	14	21	47
18	C	16	21	22	59
19	C	12	7	10	29
20	C	20	15	15	50
Total Students	I	209	192	202	603
Total Students	C	146	154	173	473
Total Students	I and C	355	346	375	1076

Intervention objectives and strategies

Eight district school foodservice directors and 10 school cafeteria managers were involved in the intervention. Six foodservice directors and 7 managers attended the one-day meeting where the intervention was explained and foodservice assistance elicited. The agenda is in Appendix B. The 2 directors and 3 managers who did not attend were provided the information during an onsite visit. No information on increasing calcium-rich foods, foodservice satisfaction, or expanding breakfast was provided to control school foodservice personnel.

Based on the results of the one-day meeting and on-site visits, 6 of the 10 schools added calcium-rich foods to their daily menus, including yogurt and calcium-fortified juices. None of the other intervention (n=4) schools made any changes in food offerings. During the posttest visit to the schools, near the end of the school year, the additional calcium-rich foods were no longer observable in 4 of the 6 schools due to schools exhausting their supply of the specially ordered food items.

The researcher provided eight 3-hour after-school training sessions for all intervention teachers (3 hours/teacher) following the pre-intervention data collection. Stipends were provided to teachers for attending the training sessions. The agenda and Web site information provided to the teachers is in Appendix B.

The intervention period originally planned for 8 weeks was reduced to 3 to 6 weeks, which reflected the amount of time that was available between pre- and post-data collection and the end of the school year. While the pre-data collection began in mid-

February, it was late March before all pretest data could be collected and training provided to intervention schools.

Pre- and post-intervention data collection

Data collection was conducted during a regularly scheduled class period ranging from 43 to 90 minutes, with the shorter periods predominating. Students were able to complete the 24-hour food recalls and the SFSS within the class period. The recalls were collected before the SFSS. Data were generated from 1034 pre- and 1049 posttest 24-hour food recalls including both the intervention and control schools. Of the 1034 pre-intervention usable recalls, 981 had no missing gender data. Of the 1049 usable post-intervention recalls, 990 had no missing gender data, 552 were from intervention schools, and 438 from control schools. The SFSS useable data included 980 students pretest and 936 posttest. There were 744-807 matched pairs in the SFSS sample, with an individual student's survey matched pre- and posttest.

Data analyses

As a crosscheck, a sample number of the recalls completed by each of the 2 nutritionists coding the data were reentered by the other nutritionist to verify the accuracy of the dietary coding. Congruence between the coders was 94% for calcium, the nutrient of primary interest in this study. The lower numbers of usable data from the SFSS may have been related to the design of the optical scanning form. Several students would fail to complete both sides of the form or would fail to include their code number.

Evaluation of intervention at student level

Mean posttest calcium intakes showed no significant changes among any group of students, intervention or control, males or females from pre- to post-intervention. Neither were there were any changes in foodservice satisfaction among any students in the study pre-to post-intervention. Additional results of the calcium intake are reported in Part 2 of this dissertation, and results of the foodservice satisfaction in part 3.

DISCUSSION

A critique of the various components of this multi-dimensional pretest-posttest calcium intake and foodservice satisfaction study provides insight into strengths and weaknesses of the methodology that can be useful when designing future interventions.

Research Design

The research design of intervention and control schools was effective in recruiting schools, teachers, and students for the study. Based on evaluations of other multi-component nutrition education intervention studies [1, 15-21], possible reasons for the lack of success of the primary objective, increasing calcium intake, include several elements as suggested in the following analyses.

A weakness of the design may be related to the time constraints of the research study. A stipulation of the grant award for this study was that the research could not begin until the grant was awarded (in this case, late December 2001) and that the study was to be completed within 12 months. This required the compression of the school-based portion of the research into four months, February through May, the time remaining in the school year after beginning recruitment of schools in late January, with

the data analyses and writing reports of study to be done during the remainder of the calendar year.

With 3 to 6 weeks for implementation, time was likely a major limititation in affecting a behavior change of the students in this South Carolina study. Nutrition and health promotion literature suggest that while program specific knowledge can be obtained in 10 to 15 hours of instruction over a 3 to 15 week period [22], 20 hours of contact time are required for changes in health practices, 40 hours are required for attitude changes, and 50 hours to integrate knowledge, attitude, and behavior [23].

It is not known how much time teachers devoted to this study because the information was not requested or collected. If a teacher devoted all of a class period (43 minutes) to this project for 3 to 6 weeks, the total amount of time would have been 10 ¾ to 21 ½ hours. However, it is not likely that any teachers devoted full time to this project.

In a summary evaluation of the Nutrition Education and Training program, St. Pierre and Rezmovic concluded that positive effects of knowledge were discernable; however, it might be unrealistic to expect a 3-10 week program to significantly change behaviors that had been formed over several years [24]. Pilot Team Nutrition studies found a positive behavior change in children's eating behaviors after 14.4 to 16 hours of a nutrition education component combined with activities linked to the school lunch room [16]. The classroom instruction occurred over 8 to 10 weeks in 7 school districts, and while there were significant but modest changes in dietary behaviors at the end of the project, the changes did not persist six months later [25].

While lack of time for the intervention to impact on student behavior in South Carolina middle schools may contribute to the lack of change in calcium intakes, there also was no formal process to evaluate teachers' use of the curricula, materials, activities, or class time devoted to the study. Without a formal process evaluation [17,18, 26] the ability to form conclusions about class time spent by teachers on curricula material, fidelity to curricula, use of materials and activities, or students' responses to the material and activities was not possible.

Another factor contributing to a lack of change may involve no further support given to the teachers after the researcher's initial training sessions. Positive increases in student knowledge, attitudes, and behaviors have been shown where consultant support was provided to teachers during curriculum implementation [13]. Additionally there was no onsite monitoring of the classroom delivery of the curricula. Onsite monitoring of intervention studies has been used to determine if classroom teachers use curricula as designed and deliver targeted behavioral messages designed to change student behavior [1, 4, 15, 17, 18, 21, 22, 29]. A coordinator for each site may have helped ensure use of materials provided by the project and assisted with collaboration between the classroom and the cafeteria as in other studies [4, 16] that showed some success in changing behavior, if only temporarily [16].

Recruitment

On-site visits and phone contacts by the researcher were effective for recruiting schools. In the 12 school districts that declined to participate, the reasons given for not participating were related to concerns about the upcoming statewide mandated testing

that was scheduled near the end of the school year. Similar reluctance to participate was reported by Lytle, Gerlach, and Weinstein [27] in recruiting schools for a junior high school intervention study. The most frequent reasons for declining participation in that study were that the teachers were (1) too busy and (2) their priority was to focus on academics, especially the state mandated tests.

In the South Carolina study, testing was not an apparent issue when school principals made the decision to participate in the study because they identified teachers who would not be affected by the testing. For example, science was not a tested subject during the study year, which may explain the larger number of Science teachers recruited.

Seeking a district level advocate such as the foodservice director might produce better recruitment results based on reports of other studies [16, 19]. In a successful fruit and vegetable intake intervention study, school foodservice directors were recruited as district level advocates to facilitate a multilevel process that took 7 months before the final phase of student recruitment began [19]. In that study classroom teachers were identified as key to the recruitment process for student participation, and greater attention to soliciting teacher support was recommended.

Having students return the written parental permission forms as required by the IRB may have reduced the numbers of students participating in the study. In another study of middle school aged children, passive parental consent was permitted and only 1.5% of parents refused to have their child participate [21]. Children were allowed to participate unless parents had phoned to request that their child not do so. While the number of non-participating students in the South Carolina study is not known, it was considerably larger than the 1.5%.

Again, time may have been a contributing factor in the participation rate, with most teachers having only a week to send letters home to the parents by the students and then have them returned. Teachers who provided an incentive for students to return the written parental permission forms had a higher response rate than teachers who did not; in those cases almost all students participated. This was a teacher-initiated practice and incentives varied by school and teacher and may have introduced a bias.

Subjects/setting

The schools in this study were representative of South Carolina middle schools based on the size of the school and the school's participation rate in the school breakfast program. Although the randomly selected schools that agreed to participate met size and participation criteria and represented rural, urban, and suburban schools, the lack of participation from the 6 large school districts with more than 30 schools may have been a bias. However, based on the number of 24-hour food recalls collected, participation from the 3 grade levels was fairly balanced. For the SFSS, the slightly lower useable data collected may reflect the difficulty that some students had in completing the form, indicated by the lower percentages of 6^{th} grader data (28%) compared to the food recall data (32%). Although the initial information provided to school principals was the need to choose classes with both genders, there were more females in the classes selected, and it was typically the males who did not return signed parental consent forms.

Intervention objectives and strategies

Working with school food service managers and directors was an essential component of this project. Directors and managers of a majority of the intervention schools (n=6) took

the initiative to order and place additional calcium-rich foods on the menu. The fact that they "ran out" of the product before the project was completed is indicative that advanced planning is necessary for procuring foods used in the school meal programs. Adding a new product to a school district's bid list requires 4 to 6 weeks advance notice including estimating quantities to be used. Also, being near the end of the school year, managers were careful not to overstock perishable foods.

Successful multidimensional nutrition education intervention studies have included extensive training, onsite visits, checklists, and other strategies to reinforce the school food service compliance with the project [1, 7, 16, 17, 22-25], Therefore, additional training and on-site visits to reinforce the project along with additional time for implementation seems necessary to reinforce this component of a similar study.

Another potential issue relating to the lack of success in changing dietary calcium intake was the appropriateness of the materials for South Carolina middle school students. While most of the materials had been evaluated and tested with middle school-age children in other states, effectiveness of the materials had not been pre-tested with South Carolina students. Also, other material provided, such as the widely used brochure, *Calcium? Are You Getting Enough?* [13] is not currently validated in the nutrition literature [30].

According to researchers in Minnesota, resources and methods to help students build skills in decision-making and life skills should be focused on a developmental, culturally sensitive framework combined with instructional strategies [31]. The focus should include application of learned skills in the school environment. Information from focus group research with adolescents in other states and with students in the middle

school grades could provide insight for conducting similar research with South Carolina students [7, 32, 33]. Focus group research with students in South Carolina middle schools would have helped direct the messages for increasing calcium intake [7, 32].

Implementation of the curriculum was cited as the biggest challenge in a middle school study that focused on increasing fruits and vegetable consumption and used peer leaders [7]. Student recruitment issues and maximizing student exposure to the classroom curriculum were also challenging. Students who participated in the component partially taught by the peer leaders had borderline statistical increase ($p = 0.056$) in fruit and vegetable consumption, but the peer leaders increased their own fruit and vegetable consumption significantly. Students who were exposed only to the school food service component, which included changes in the school cafeteria to promote greater availability of fruits and vegetables, did not increase consumption of fruits and vegetables [7].

Pre- and post-data collection

Conducting the 24-hour food recalls and the SFSS within the regularly scheduled class periods was feasible but required clear instructions and visual aids to assist students in completing the recalls. Displaying foods with varying portion sizes helped students visualize the amounts of food and beverages they consumed. The researcher performed all of the data collection and did not leave this responsibility to the teachers. The SFSS forms were a slight problem in that each form was two-sided, requiring the student to turn it over after completing the first side. Recognizing this as a problem the researcher had to monitor this to ensure students completed the entire form.

Data analyses

Data analysis for the 24-hour food recalls was aided by obtaining school food service recipes and manufacturers' nutrient analyses for foods prepared and served at school. Having the specific products used in school meals helped increase the accuracy of the nutrient analyses. If the SFSS forms are used, careful monitoring of the data completion process is necessary to ensure students answer all of the questions.

Evaluation of intervention at student level

While this intervention study did not show a significant effect on calcium intake, student data confirmed that calcium consumption was less than the 1300 mg/per day of Adequate Intake (AI) [33] recommended for middle school children; thus, there is a need for an effective calcium intervention. Additional research is needed to develop an intervention to directly target South Carolina students at risk for low calcium intakes.

APPLICATIONS AND CONCLUSIONS

- Although the intervention designed to increase calcium intake of students did not result in positive changes in dietary behavior, analyses of the components of the intervention identified strengths and weaknesses of the study design.
    - Strengths of the study included the randomized control design; successful recruitment of schools; inclusion of classroom and cafeteria experiences for students; and participation of the researcher in pre- and post-data collection and data analysis of 24-hour food recalls.

- Weaknesses of the study included the lack of a formal process evaluation to monitor the implementation of the intervention; recruitment issues related to return of parental permission forms (including inconsistencies created by teacher provided incentives); initiation of the study with less than half of the school year available for recruitment, pre- and posttesting and intervention; and no pilot testing of the components of the intervention in a smaller sample of schools to determine the effectiveness of the intervention processes and materials with the target students.

- For a multi-district school-based intervention, identifying a district coordinator to help facilitate recruitment and serve as a liaison with school administration, school foodservice personnel, teachers, and parents may increase the possibilities for success of an intervention.
- The evaluation of the intervention was based on mean calcium intakes and foodservice satisfaction scores of individual students, but the intervention itself was at the classroom and cafeteria level.
    - Provide focus at the individual level, allowing each student to consider his/her unique, tastes, and calcium needs.
    - Provide opportunities for individuals to select calcium-rich foods in the school environment to encourage calcium intake.
    - Explore other places in the school environment where calcium messages might be placed.

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Part 5

The Middle School Environment and Food and Beverage Availability During Lunch Periods

This part is a lightly revised version of a paper by a similar title published in the journal *Topics in Clinical Nutrition* in 2004 by Lippincott Williams & Wilkins:

Pilant, VB, Skinner JD. Availability of competitive foods and beverages during lunch in middle schools. *Topics in Clinical Nutrition,* March 2004, p. 20 -27.

My primary contributions to this paper include the selection of the objective, development of the procedure for obtaining the information, training an assistant to identify and record the foods and beverages in schools during lunch, observing students during lunch periods in all of the 20 schools, obtaining school meal production records, reviewing and interpreting the data, reading and interpreting the literature, and writing most of paper.

ABSTRACT

Objective To understand the total eating environment in middle schools by determining the food choices available that complement the National School Lunch Program (NSLP), and the number and types of food available that students may choose other than the NSLP meal components during the lunch period.

Design This was an observational study conducted as part of a larger calcium-intake study of children attending selected South Carolina middle schools.

Subjects/setting The 20 schools studied were a randomly stratified sample selected from the total number of schools (n=163) in South Carolina that included grades 6, 7, and 8.

Main outcome measures All foods and beverages available for sale in vending machines, school canteens, and school cafeteria lines during lunch periods were identified and recorded.

Results The mean number of food and beverage items available in addition to school lunches was 21.7 with a range of 0-62 items in the 20 schools.

Applications/conclusions Extensive choices of foods and beverages available to students in 20 South Carolina middle schools during lunch periods are competitive with more

nutritious school meals. All foods and beverages sold or served to students, including those available outside the school meal programs should be addressed in policy at either the school, district, or state level since USDA regulations are inadequate to affect these issues.

INTRODUCTION

As required by the "Healthy School Meals for Healthy Americans Act of 1994" (P.L. 103-448) [1], schools that participate in the National School Lunch Program (NSLP) and the School Breakfast Program (SBP) are required to serve meals that meet the *Dietary Guidelines for Americans* [2]. The "Healthy School Meals" act was an amendment to the National School Lunch Act [1] and was implemented by the U. S. Department of Agriculture (USDA) under the regulations known as the Healthy School Meal Initiative for Americans or School Meal Initiative (SMI) [3]. However, standards established by the U.S. Department of Agriculture (USDA) for reimbursable school meals under the SMI do not apply to ala carte foods sold in the cafeteria and to foods sold in snack bars, school stores, or vending machines. The American School Food Service Association (ASFSA) adopted the position that all foods and beverages served at school should be consistent with the Dietary Guidelines for Americans, not just for school meals as the current law provides [4].

While school meals have improved in nutritional quality since the initiation of the SMI [3], other foods and beverages offered at school, labeled as competitive foods by USDA [5], are becoming of increasing concern to many health and nutrition related organizations [6-10]. USDA defined competitive foods as foods of minimal nutritional

value (FMNV), such as carbonated beverages, water ices, chewing gum, and certain candies, and all other foods offered for individual sale other than meals served through USDA's School meal programs. These foods range from a second serving as part of the school meal to foods that are sold in addition to or in place of reimbursable school meals, such as ala carte sales and other foods and beverages purchased from vending machines and school stores [5]. Under current program regulations the sale of FMNV are prohibited in the foodservice areas during the school meal periods (7 CRF 202.11(b)). Regulations do not prohibit their sale outside the foodservice area at any time during the school day.

These practices are of particular concern because adolescents have been reported to drink twice as much soda as milk [10]. Soft drinks reportedly displace milk as a beverage that contributes essential nutrients to children undergoing rapid growth [11, 12]. Researchers also have explored the connection between consumption of sugar-sweetened drinks and childhood obesity [13-14]. The shift in providing children with greater access to competitive foods has the potential to erode the positive influences of school meals [13, 14]. Studies consistently show that for many children, meals and snacks consumed at school make a major contribution to many children's total daily consumption of food and nutrients [14-16].

While children may understand that good nutrition and good health are related, this understanding may not be reflected in their food choices and meal patterns while at school [6]. Food choices at school are influenced by the total eating environment in the schools, including types of foods available throughout the school, nutrition information in

the cafeteria and around the school, nutrition education provided in the classroom, and nutrition promotions that reach families [6].

To understand the total school eating environment, an assessment was conducted in 20 randomly selected schools to determine the availability of foods and beverages to children during lunch periods. Items sold in vending machines, in school canteens, (e.g. school stores) and in the school cafeteria serving lines were identified.

METHODS

Twenty middle schools enrolled in both the NSLP and the SBP were participating in a research project about increasing calcium intake of 6^{th}, 7^{th}, and 8^{th} grade children. The randomly stratified sample was selected from the total number of schools (n = 163) in South Carolina that included all three grades and no grades below 5 or above 8. Schools were stratified on the basis of student enrollment and participation in the SBP. The study sample included smaller schools (less than 800 students) and larger schools (800 or greater) in rural, suburban, and urban areas in various parts of the state. See map in the Appendix D for locations of schools in the study. A trained consultant conducted an assessment of the school nutrition environment in each school during a one-day visit between mid-February and late-April of 2002 to determine the availability during lunch periods of snack foods, beverages, and ice cream in addition to foods served as part of the federally reimbursed lunch. To distinguish carbonated from non-carbonated soft drinks, sodas were defined for this study as carbonated beverages, and soft drinks were defined as non-carbonated beverages, such as fruit flavored drinks, athletic drinks, iced tea, and lemonade.

All foods and beverages available for sale during the lunch periods were identified. Observations were made of cafeteria serving lines, locations of milk and other beverages, school meal components and ala carte items. Competitive foods, i.e. snack foods, beverages, were identified in school canteens (school stores), vending machines, and school cafeteria serving lines, and lists were compiled by school site. Master lists of the totals of all beverages, snacks, and ice cream items offered by schools in the study were developed. School foodservice menus and production records were obtained to determine the school meal components offered as part of the reimbursable school meal as well as availability of ala carte items. The lists of available foods and beverages were classified according to the source of the items, e.g., vending machines, school cafeteria, etc. This environmental review included foods served on a daily basis and did not include student candy sales or other special class events that included the serving of food and/or beverages.

RESULTS

The mean number of food and beverage items sold during lunch periods, other than NSLP meal items and ala carte entrees, was 21.7 with a range of 0–62. A total of 356 of these items were available in the 20 schools. No milk, fresh fruits, vegetables, yogurt, or entrees were sold outside the school cafeteria in any of the 20 schools. Table 1 provides a summary of the various foods and beverages and the number of choices offered as part of a school lunch for entrees, fruits, vegetables, and juices (FVJ in the table), and milk. In addition, ala carte entrees and competitive foods and beverages available during lunch periods are indicated. FMNV were not sold in the cafeteria, but in some schools the

Table 1. School meal participation, [a] lunch choices, [b] ala carte entrees and sales, other foods, [c] and soft drinks/sodas [d] available in 20 South Carolina middle schools during lunch periods.

School	ADM [a]	NSLP % Participation	SBP % Participation	Entrée Choices	FVJ Choices	Milk Choices	Ala Carte Entrées #	Ala Carte Sales $	Other Foods	Soft Drinks/ Sodas
1	696	64	19	5	6	2	0	300	25	12
2	896	50	6	5	6	2	0	300	22	10
3	662	62	19	1	2	3	0	200	15	4
4	840	63	16	1	2	3	0	200	0	7
5	607	75	57	2	3	3	0	200	6	5
6	504	77	27	3	2	2	0	100	4	6
7	562	69	31	2	3	4	0	75	0	1
8	757	78	22	5	8	3	2	400	3	7
9	659	81	23	1	2	3	0	150	13	6
10	293	51	15	2	2	5	0	150	22	10
11	1185	55	13	3	4	4	0	300	3	16
12	931	87	19	4	6	4	0	150	0	0
13	859	23	16	3	2	4	8	530	29	7
14	1042	22	14	3	6	3	8	570	46	22

Table 1. Continued.

School	ADM [a]	NSLP % Participation	SBP % Participation	Entrée Choices	FVJ Choices	Milk Choices	Ala Carte Entrées #	Ala Carte Sales $	Other Foods	Soft Drinks/ Sodas
15	418	77	26	1	6	3	0	75	15	4
16	529	78	24	4	6	3	0	150	10	7
17	444	83	30	2	2	4	0	125	0	5
18	850	71	19	4	6	4	0	200	26	12
19	336	78	15	4	6	4	0	130	2	15
20	435	51	18	3	5	5	1	200	29	13
Means	675	62	19	3	4	3.4	1	225	13.2	8.5
SD	242			1.4	2	0.9	2.5	139	9.9	4.0

[a] Participation is the average number of meals served per day based on average daily membership (ADM). Lunch (NSLP) % participation averages 62% (range 22-87%) and Breakfast (SBP) participation averages 19% (range 6-57%).

[b] Lunch choices shown are components of a reimbursable meal and include, the number of entrees; fruits, vegetables and juices (FVJ); and milk. Ala carte entrees are not meal components but are offered by the school cafeteria.

[c] Other food options include foods that are not part of a school meal but are for sale in vending machines, in school canteens, or by the school cafeteria during lunch periods.

[d] Soft drinks/sodas include the number of choices sold during lunch periods. Students were permitted to bring sodas into the cafeteria after purchase from vending machines or school stores, and sodas were also sold in the 2 schools that did not require all students to go to the school cafeteria.

vended food items could be brought into the dining area. The dollar volume of ala carte sales includes sales of ala carte foods, extra sales of school meal components, other foods, and/or beverages in the school cafeteria, but the two schools with 8 ala carte entrees had the highest ala carte sales (over $500 per day) and the lowest number of reimbursable school meals as indicated by the lunch participation of 22% and 23%, respectively.

Beverages

Milk was provided with reimbursable NSLP meals and was in traditional reach-in milk coolers except in two schools where the milk was placed on the refrigerated section of the serving lines. Milk, a component of the NSLP meal [3] came from 5 different dairies and included flavored and unflavored milks. Chocolate nonfat or lowfat milk was the most popular milk served by all schools; 15 schools served nonfat chocolate milk, 2 served 1/2% fat milk, and 3 served 1% fat milk. Other flavored milks (vanilla and strawberry) were offered in 15 schools; the majority of these milks were 1% fat but some were nonfat. Twelve schools provided 2% fat unflavored milk, 3 schools provided 1% fat unflavored milk, and 5 schools offered whole, 3.3% fat, unflavored milk.

Milk selections offered in the schools were in gable, paper cartons except in one school that used pouches, made of soft flexible plastic material. The latter packaging reduces the volume during storage and reduces waste volume. However, the milk in the pouches was not prominently displayed as compared to other beverages such as iced tea and soft drinks that were placed at the end of the serving line next to the cashier. The

placement of milk at that school possibly contributed to less than one-fourth of the students choosing milk to drink at lunch.

The total number of different non-milk beverages offered in the 20 schools during lunch periods was 122; 43 were carbonated beverages (e.g. sodas, pop), 8 of which were diet drinks and 5 were decaffeinated. While FMNV were not sold in the food service area in any of the schools, they were available in 4 schools during the lunch period. Only three brands of 100% juices were offered in the vending machines. There were 3 selections of water, and 73 varieties of non-carbonated soft drinks, such as fruit flavored drinks, athletic drinks, iced tea, and lemonade. Six schools offered sweetened iced tea for sale on the cafeteria serving line.

Vending machines selling non-carbonated soft drinks were frequently found in the school cafeteria and were usually operated by the foodservice department. Some school cafeterias sold soft drinks on the line or by the cashiers' stations. Five of the 20 school cafeterias sold a chocolate flavored soft drink with milk as an ingredient that provided 100 mg of calcium, compared to 300 mg calcium in nonfat chocolate milk. There were no consistent patterns among schools for placement of the soft drinks, vending machines, or canteens. In only one school cafeteria, where no alternate beverages were permitted or sold, almost all students drank milk, the only beverage offered.

None of the schools in this study had an exclusive contract with a specific cola company as evidenced by the large variety of beverages available. Caffeine content of the beverages was an expressed concern of at least two school principals. Neither principal allowed the school cafeteria to serve tea because of the caffeine content, and they

attempted to only include caffeine free products in vending machines; however, there were numerous products with caffeine offered in one school's vending machines.

Snacks

A total of 203 snacks were sold in various locations during lunch periods in the 20 schools; 104 were sweet snacks, such as candy or baked items, e.g. pre-packaged honey buns or cakes. The other 99 items were salty snacks and included many varieties of chips, crackers, popcorn, jerky, and pork rinds. These were usually sold in vending machines unless there was a canteen. Some school foodservice programs sold a limited variety of these items, but one school had a total of 42 different prepackaged items (sweet and salty) and soft drinks sold along with school meals. This was equivalent to having a school canteen operating within the school foodservice area and competing with the foodservice program.

Ice Cream

Only six of the 20 schools sold ice cream. Sometimes it was sold by school foodservice and sometimes by an organization within the school. It was sold in vending machines or from ice cream freezers, usually in the cafeteria, but also in at least one canteen. A total of 31 ice cream items from 6 manufacturers were offered during lunch periods. In schools that offered ice cream, it appeared to be a popular selection. Several school cafeterias occasionally had ice cream or fruit sherbet on their lunch menus.

DISCUSSION

The total number of snacks and beverages (n=356) offered in the 20 South Carolina schools was similar to another middle school study in 24 schools where the total number of snacks and beverages were documented at 357 items [18]. In that study, food options other than school meals were found in all 24 schools; ala carte items were sold in 23 of the school cafeterias, student stores sold food in 13 of the schools, and vending machines were available in 7 of the 24 schools [18].

The number and variety of school milks offered by the schools was a positive finding. The South Carolina (SC) middle schools in this study served more lower-fat milks than schools in the national School Health Policies and Programs Study 2000 (SHIPPS 2000) [7], i.e., 75% of SC middles schools vs. 10% of SHIPPS schools ordered chocolate or flavored skim milk. This was consistent with other milks, 1% unflavored milk– 15% vs. 4%; 2 % unflavored milk – 75% vs. 65%; and whole unflavored milks – only 25% of SC schools vs. 46% of SHIPPS schools.

While children's eating habits are shaped by a variety of influences, schools are a critical part of the social environment that shapes these behaviors [19]. Studies indicate that school meal programs contribute to better nutrition and healthier eating behaviors for children who participate, but competitive foods can undermine the nutrition integrity of these programs and discourage participation [5]. Because of the negative effect on meeting nutrient recommendations and the possible health consequences, nutrition education messages targeted to children and/or parents should encourage limited consumption of soft drinks including carbonated beverages [11]. In addition, policies that limit children's access to soft drinks and carbonated beverages at school should be

promoted. Children receive a mixed message when the value of healthy food choices is taught in the classroom and students then encounter school vending machines with a wide assortment of snack foods and beverages that are not based on meeting nutrition standards.

This study of school eating environments confirmed that there are competitive foods issues that need to be addressed in South Carolina communities, schools, districts, and/or the state as a public policy issue. The practice of offering these alternatives to children at a critical stage of growth and development in early adolescence undermines the purpose of the "Healthy School Meals for Americans Act" [1] that requires that school meals meet the *Dietary Guidelines for Americans* [2]. If a school's setting is intended to be a learning environment for children, the issue of healthful food choices needs to be a priority. The Federal Competitive Foods Rule [5] limits a few foods and beverages (e.g. carbonated beverages, water ices, hard candy and chewing gum) from being sold in the school food serving area. However, other foods and beverages that compete with school meals are allowed.

In lieu of federal or state standards, school districts or individual schools must take action [20]. A national consensus panel on school nutrition recommended the development of nutrition standards for elementary and secondary schools that included recommendations for school beverages, snacks, sweets, and side dishes [21]. The secondary school standard promotes consumption of fruit juices, water, and milk while eliminating beverages with little or no nutritional value. The standards for snack foods limit fat, saturated fat, sugar, and portions to specific sizes, including a portion size limit on lunch items. Another standard requires that quality fruits and vegetables be made

available any place that competitive foods are sold. To meet the standard for beverages the Los Angeles Unified School District, the nation's second largest school district, received national attention when they eliminated the sale of sodas from all sites accessible by students and only healthful beverages (water, milk and some juices and sports drinks) will be sold beginning in January 2004 [22].

The National Association of State Boards of Education (NASBE) provides guidance on developing a comprehensive, integrated policy with the purpose of promoting lifelong healthy eating among students and school staff [23]. A sample policy that addresses all aspects of the school setting that may influence eating patterns is included in the guidance material. NASBE recommends that all food and beverages sold or served to students, including those available outside of the school meals program, be addressed in the policy.

APPLICATIONS AND CONCLUSIONS

- The extensive access to foods and beverages of minimal nutritional value offered to South Carolina middle school children during lunch periods are competitive with more nutritious school meals
- The prevalence of providing beverages as an alterative to milk in South Carolina middle schools is widespread and limiting access to less nutritious beverages should be considered as part of food standards and policies.
- All food and beverages sold or served to students, including those available outside of the school meals program should be addressed in policy at either the

school, district, or state level since USDA regulations are inadequate to affect these issues.

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APPENDICES

APPENDIX A

24-HOUR FOOD RECALL

Eat Right/Be Right
2002

Code: _____
Age: _____
Female:____ Male_____
Date: _____

24-HOUR FOOD RECALL

	Food and Description	Amounts
1st time food was eaten: Time ____ AM __ PM __ Where _____ _____ With whom _____ _____		
2nd time food was eaten: Time ____ AM __ PM __ Where _____ _____ With whom _____ _____		
3rd time food was eaten: Time ____ AM __ PM __ Where _____ _____ With whom _____ _____		
4th time food was eaten: Time ____ AM __ PM __ Where _____ _____ With whom _____ _____		
5th time food was eaten: Time ____ AM __ PM __ Where _____ _____ With whom _____ _____		

	Food and Description	Amount
6th time food was eaten: Time ____ AM __ PM __ Where _____ _____ With whom _____ _____		
7th time food was eaten: Time ____ AM __ PM __ Where _____ _____ With whom _____ _____		
8th time food was eaten: Time ____ AM __ PM __ Where _____ _____ With whom _____ _____		
9th time food was eaten: Time ____ AM __ PM __ Where _____ _____ With whom _____ _____		

If you ate more than 9 times, use the back of this sheet.

After completing this form, check yourself by answering the following questions:

1. Have you listed everything you ate and drank during the day?
2. Did you include the amount (i.e., 1 orange, 1 cookie, or 1 cup, 1 Tbsp., 1 tsp.) of each item consumed?
3. Did you describe the way the foods were prepared (i.e., egg – scrambled, fried, boiled)?
4. Did you describe, in as much detail as possible, the ingredients in casseroles, salads, sandwiches, soups and other mixed dishes?
5. Did you remember to list everything you added to your food before you ate it (i.e., sauces, gravies, butter, salad dressings, catsup)?
6. Did you add anything to your beverages (sugar, cream, milk, etc.)?

APPENDIX B

MATERIALS FOR TRAINING SESSIONS

EAT RIGHT/BE RIGHT RESEARCH PROJECT
Kick-Off Meeting for School Food Service Personnel
Agenda
March 1, 2002

8:30 AM	**Registration and breakfast**
9:00 AM	**Introductions and overview of project** Vivian Pilant- Office of School Food Services and Nutrition
9:30 AM	**Why calcium and why breakfast?** Vivian Pilant- Office of School Food Services
10:00 AM	**Results of focus groups with middle school students** Kelli Kenison and Carol Rheaume- Focus group leaders
10:30 AM	**Break**
10:45 AM	**Expanding Breakfast** Molly Szymanski- Southeast United Dairy Industry Association, Inc Dottie Ryan – Southeast United Dairy Industry Association, Inc.
11:30 AM	**Review of procedures for keeping milk cold** Molly Szymanski- Southeast United Dairy Industry Association, Inc Dottie Ryan – Southeast United Dairy Industry Association, Inc.
12:15 PM	**Lunch Break**
1:00 PM	**Strategies for increasing calcium intake** Examples and samples and other sources of calcium
1:30 PM	**Marketing strategies and school events** Communicating with teachers, school staff, and parents
2:00 PM	**School Food Service Satisfaction Surveys**
2:15 PM	**Records to keep**
2:25 PM	**General discussion, questions, and concerns**
2:45 PM	Adjourn

EAT RIGHT/BE RIGHT RESEARCH PROJECT
In-service Training for Teachers
Agenda

Introductions and overview of project
Vivian Pilant- Office of School Food Services and Nutrition

Why calcium and why breakfast?

Review of Report Card on Children's Health

Distribution of Curriculum Materials

Oregon Dairy Council Materials
Curriculum guide and masters for "Exercise Your Options"
Posters – What's Normal Supposed to Look Like Anyway?
Interactive Computer games- Pyramid Explorer
Brochure – Calcium, Are You Getting Enough

National Dairy Council and SUDIA
Comparison Cards
Calcium video and teacher's guide
Skate board key chains for boys

National Bone Health Campaign
Powerful Bones, Powerful Girls
Website and calendars for girls

Teen Calcium Website!
Uses the World Wide Web as a
teaching tool for teens to learn the importance of calcium.

Other Websites

School Food Service Strategies for Increasing Calcium Intake
Breakfast, lunch and snacks

Expanding Breakfast
South Carolina Middle School Focus Group Results

Nutrition Related Websites

With General Nutrition and Calcium Focus

www.whymilk.com

www.nutritionexplorations.org

www.got-milk.com

www.eatsmart.org

www.navigator.tufts.edu

www.oregondairycouncil.org

http://www.nationaldairycouncil.org

http://calcium.tamu.edu

http://www.powerfulbones.com

APPENDIX C

METHODOLGY

METHODOLOGY

RESEARCH DESIGN

This study was a pretest-posttest randomized group design with treatment and control groups. Prior to the study, approval was obtained from the Institutional Review Board of the University of Tennessee and from officials in the school districts. The overall objective was to increase calcium intake of South Carolina middle school children. Potential participants for this project were middle school children enrolled in 20 public schools selected at random from 163 middle schools in South Carolina.

A multiple channel approach for reaching students through this project was selected to enhance overall success. The purpose of using a comprehensive approach was not to determine the most effective channel or means of increasing calcium intake, but to provide an environment that supported an increase in calcium consumption through strategies that appealed to middle school children with varying sociocultural needs and learning styles.

Selection of schools for project

All public schools in South Carolina participate in both the National School Lunch Program (NSLP) and the School Breakfast Program (SBP) [1]. A list of schools participating in the federally funded school meal programs during school year 2001-2002 inclusive of grades 6, 7, and 8 was obtained from the Office of School Food Services and Nutrition. Of the 210 schools with the middle grades, only schools that included all three grades, 6-8, were eligible for the study reducing the number of schools to 163. Only grades 6-8 were studied in those schools.

The average SBP participation in the 163 schools was 19% of the Average Daily Membership (ADM). This is compared to an average of 18% for middle schools reported in the School Health Policies and Programs Study 2000 [2], and compared to 24% of the South Carolina state average for all schools grades K-12 in school year 2000-2001.

Participation in the SBP varied among school grade levels with highest participation occurring in elementary schools, grades K-5. Middle schools with 799 and fewer students typically had schools with participation higher than the state middle school average of 19%, and those with membership above 800 had fewer schools at or above the middle school average of 19%. The number of students who were eligible to receive free or reduced price meals did not seem to be as great a predictor of higher participation in school breakfast as did the factor of school size. To allow for these differences in participation and by size and participation, four categories were established for the sample.

A sample size of 20 schools, 10 for each treatment was determined to be a reasonable sample size that would permit the investigator to collect the data in a reasonable time considering the logistical controls. The 163 schools were arranged into one of four categories, (1) schools with 198 to 799 ADM with breakfast participation at or below the state average of 19% for middle schools; (2) schools with 198 to 799 ADM with participation above 19%; (3) schools with 800 -1300 ADM with breakfast participation 19% or below, and (4) schools with 800 - 1300 ADM with schools above the state average for middle school breakfast participation. Based on the number of schools in each category, a representative sample of schools was selected for each category. The sample included 4 schools in category 1 (2 intervention and 2 control

schools), 6 schools in category 2 (3 intervention and 3 control), 8 schools in category 3 (4 intervention and 4 control), and 2 in category 4 (1 intervention and 1 control), for a total of 20 schools, (Table C-1).

A random list of schools in the four categories described above was computer generated (SPSS 11, Chicago, IL). Schools at the top of each random list for each category were selected according to the needed numbers of intervention and control schools in each category. The first school on each respective list was designated as an intervention school, with the school next on the list designated as a control school. The process was repeated until the total number of intervention and control schools was selected. Ten schools were designated as intervention and 10 schools as control sites.

Letters were sent to the school superintendents seeking their permission to contact the school principals and subsequently recruit teachers and students in each of the 20 schools. If the superintendent declined permission or if school personnel declined participation, the superintendent with the next school in the appropriate category on the random list was contacted. The final 20 schools successfully recruited represented 15 of 86 public school districts and were located from the low country on the southeastern coast, to the midlands, and to the Appalachian foothills (Appendix D). Rural, urban, and suburban schools were in the intervention and control samples.

Based on recommendations from the school principal of each school, a teacher at each grade level, 6-8 was invited to take the lead in promoting the nutrition education project for their grade level. One class per grade per teacher was selected as the school's intervention group for the pre-and posttesting.

Table C-1. Array of representative sample of twenty schools, intervention and control, in South Carolina middle school project based on number of schools in each of four categories.

	SBP Participation 19% or below	SBP Participation Above 19%	TOTALS
Schools with ADM 198-799			
Intervention Schools	2	3	5
Control Schools	2	3	5
Schools with ADM 800-1300			
Intervention Schools	4	1	5
Control Schools	4	1	5
Totals			
Intervention Schools	6	4	10
Control Schools	6	4	10

Pre- and post intervention data collection

Data were collected from mid-February to late-May 2002, pre- and post- intervention in 6^{th}, 7^{th}, and 8^{th} grade classrooms (at least one class per grade) in the 20 schools. Student data included 24-hour food recalls (Appendix A) and School Foodservice Satisfaction Surveys (SFSS), a validated instrument purchased from the National Food Service Management Institute (NFSMI) [3]. The number of students from each class varied by the number of students in each class and by the number of returned, signed parent permission forms. Based on guidelines of the Institutional Review Board (IRB) at the University of Tennessee (UT), students were not allowed to participate in the data collection phase of the project without parental permission.

The teacher was responsible for sending letters provided by the researcher to parents or guardians explaining the project and requesting their written consent. The 24-hour food recall or SFSS was not given to any student who had not returned the form or

whose parent or guardian had denied consent. The student remained in the class during the process even if he or she was not participating.

Teachers were requested to maintain the parental consent and student signed assent forms and the coding documents in a safe and secure place available only to her or him during the duration of the project and up to three years totally as required by the UT IRB. A small portable file was provided for this purpose. Teachers were requested to remain in the classroom during the administering of the food recalls and surveys. The teachers were not to know the results of the surveys by individual children, and the researcher was not to know the names of any of the children.

Student names were not placed on the data collection forms; however, a three digit pre-code number was preprinted on each 24-hour food recall form so that the data could be linked pre- and post-intervention. Each student was then assigned a two-digit number to add to the pre-code. The resulting five-digit code number was also used for the SFSS. Teachers' assistance was requested to assure the coding for each child was entered correctly during all data collection, as the child's name was not on the data collection forms. Details of the coding, including a form for teachers to enter student names was provided to each teacher prior to the first data collection. The first digit of the pre-code was changed for the second data collection period to enable tracking of individual responses, pre- and post-intervention.

The 24-hour food recalls, pre- and posttest, coded by student number, were administered to the students by the researcher in both the intervention and control schools, in a classroom setting. Each participant signed an assent form prior to the first data collection after the study and procedures were explained; students were informed

that participation was voluntary as required by the UT IRB. The food recalls were conducted on a midweek day so that the recalls would reflect a weekday rather than a weekend day or holiday.

Each student entered the last two numbers of their specific code, their age, and gender. After an explanation of how to use the form, the researcher prompted the students to record all foods and beverages they had consumed during the previous 24 hours, from the time they got up in the morning until they went to bed at night. Each time period of their day was included; after getting up and before coming to school, on the way to school, after getting to school and before class, after school started and before lunch, after lunch and before going home, after school, on the way home from school, after arriving at home or place they went after school, late afternoon and early evening, and time before going to bed. They were prompted by times they ate and not by specific meals even though each of them was scheduled for a lunch period during the school day.

The 24-hour food recall (Appendix A) was divided into three columns; the first column was divided into times food was eaten - 1st time food was eaten, 2nd time food for up to a potential 14 eating occasions. (This was reduced to 9 eating occasions posttest as this was determined an adequate number for recording responses). A separate eating occasion was regarded as a lapse of at least 30 minutes between times to eat. For each time food was eaten, a place was provided for recording the time of day, AM or PM along with where and with whom they ate. The second column included a space for recording food and beverages along with a description for each food eaten on each occasion. The third column was reserved for the amount of food or beverage consumed each time.

Students were requested to be as specific as possible for each food item, providing brand names of foods, if known. This was extended to candy, beverages, and other prepackaged items. As an example, students were told that there are many types of breakfast cereals with different ingredients, including some presweetened and others not. Another example was to describe the way eggs were prepared: fried, scrambled, boiled, or other. Chicken could be fried, baked, barbecued, or simmered. Milk was whole, 2%, 1%, or nonfat, flavored or unflavored. Students were prompted to include any food items they might have added to their food before eating, such as sugar, ketchup, or salad dressing. If they had a mixed dish such as pasta, they were to indicate what foods were in the dish or if the food was pizza, the toppings on the pizza. If the student had bread or sandwiches they were to indicate what kind of bread and what was on the sandwich, including condiments. If they ate food from a restaurant, they were to indicate the name of the restaurant and the brand name, if any, of the food they ate. While naming brand names of sodas, they were to indicate if it was a diet soda.

Food models purchased from Nasco [4] were used to assist students in estimating portion sizes of foods eaten. Cartons of all types of milk and fruit juice served at each respective school were also used to prompt memory of their selections. A 12 ounce aluminum drink can, a 20 ounce plastic drink container, a 6 ounce glass and 12 ounce glass were used to assist in estimating fluid ounces of beverages. Bowls were used to estimate foods typically served in bowls. The 3/4 cup of self-serve cereal used by schools in the SBP was compared to cereal in a 1 cup bowl to assist in estimating cereal poured from a box at home. A standard size slice of pizza size was shown, as well as a small plate of spaghetti with meatballs to indicate how to report mixed dishes. Serving sizes of

foods representing 1/4 cup, 1/2 cup, 3/4 cup, and 1 cup were on display. Portions of meat and poultry in ounces were used to assist students in estimating serving sizes, particularly at home. Because school menus and portion sizes were known, students were prompted to indicate the amount of the servings they ate, such as one serving, two servings, or more. If they took a food item, but only ate a portion of it they were to indicate the portion they ate. Only foods actually eaten were to be listed. Food portions in chain restaurants could be listed as one portion if they named the food item, but the size of French fries and beverages (regular, medium, large, or super size) were to be indicated. Students were encouraged to ask questions to help complete the food recalls. After most students had completed the recalls, the researcher verbally asked the following 6 questions to assist them in recalling anything they may have forgotten to list:

1. Have you listed everything you ate and drank during the day?
2. Did you include the amount (i.e., 1 orange, 1 cookie, or 1 cup, 1 Tbsp., 1 tsp.) of each item consumed?
3. Did you describe the way the foods were prepared (i.e., egg – scrambled, fried, boiled)?
4. Did you describe, in as much detail as possible, the ingredients in casseroles, salads, sandwiches, soups and other mixed dishes?
5. Did you remember to list everything you added to your food before you ate it (i.e., sauces, gravies, butter, salad dressings, catsup)?
6. Did you add anything to your beverages (sugar, cream, milk, other)?

These questions were also included in written form at the end of the recall form. Following the completion of the 24-hour food recalls the researcher then administered the

SFSS [3] to the same students. Each student entered the same code number entered on the 24-hour food recall. The form was a computer-scanning sheet that students used to "bubble in" their answers to the 26 questions using a 7-point scale (1 = low and least satisfied and 7 = high or most satisfied) with an additional option of "I don't know" [5]. Questions regarding participation in the school meal programs, gender, age, and grade were also asked.

Intervention and control school objectives

Design of the study was a pretest-posttest randomized group design with treatment and control groups. Approximately 1150 students participated in the study and were from at least 60 selected classrooms, from each grade per school (6-8) in each of the 10 intervention and 10 control schools. Intervention strategies were planned for two levels: school foodservice and selected classrooms. Evaluations were conducted in the school cafeteria and with individual students in the selected classrooms. The strategies for the intervention schools and corresponding treatments for the control schools at the two levels are shown below.

The overall objective of the study was to increase calcium intake in selected middle schools by using a social marketing approach to appeal to all middle school children but also subgroups of middle school children prone to breakfast skipping, i.e., females and low income students.

- School foodservice objectives
    - To increase student access to school breakfast in intervention schools by promoting use of alternate strategies suggested in "Expanding Breakfast" materials provided by the project to school cafeteria managers and directors.
    - To increase the availability of calcium-rich foods offered in the school meal programs.
- Objectives for selected classrooms
    - To promote teacher awareness of importance of calcium intake and sources of calcium by middle school children through in-service training and by providing resources and instructional materials focused on calcium.
    - To encourage classroom focus on consumption of recommended servings and sources of calcium-rich foods and on the role of physical activity in bone development by providing age-appropriate and gender-specific educational and promotional materials to participating classrooms.
    - To increase student interest in calcium and nutrition in an interactive format by providing teachers with age appropriate, gender specific, Web-based sites and activities designed for promoting calcium intake and suitable for use in a computer lab exploration.

Control schools

Calcium intake was not discussed in the control schools at either the foodservice or classroom level and neither were alternate strategies for increasing breakfast. No attempt was made to increase the availability of calcium-rich foods offered in the school meal

program and no in-service training or specific calcium-related information was provided to teachers in the control schools for the duration of the study. At the end of the study the calcium-related materials provided to intervention schools, including those targeted to students, were provided to teachers and students in control schools

Nutrition-related teaching materials for middle school students, with lesson plans, were provided to all teachers in the intervention and control schools. Teaching materials developed for 11-15 year-old students focused on the importance of a balanced diet and regular physical activity for an overall healthy lifestyle. Teachers were also provided a teaching set of Comparison Cards [7] copies of the Food Guide Pyramid [8], and teen body image posters "What's Normal Supposed to Look Like, Anyway" [9]?

Intervention strategies

School foodservice

School foodservice directors and cafeteria managers from the ten intervention schools were provided in-service training relevant to the project goals and strategies. A one-day meeting was conducted in early March, before the teacher in-service training was provided in the intervention schools, to encourage school food service personnel to promote an increase in calcium-rich foods in school meals such as expanding school breakfast participation through conventional and alternative methods. The meeting agenda is in Appendix B. The Child Nutrition Foundation's Expanding Breakfast manuals [6] were distributed along with information about possible ways to increase calcium consumption in school meals. Use of calcium-rich foods in menu items other than the required offering of milk was discussed.

Selected classrooms

For the participating classrooms in intervention schools additional information for teachers on calcium was provided at the beginning of the project and after the collection of the baseline data. Materials focused on information and messages relevant to subgroups of the middle school students who are more prone to skip breakfast, and consume less calcium, i.e., females. In addition to providing nutrition education curriculum materials specifically designed for middle school students, in-service training was provided to teachers in intervention schools to promote the inclusion of, and focus on, the calcium-related materials in classroom activities, including Web-based sites. The training included information on calcium requirements for the various age groups with specific focus on middle school children. Stipends were provided to the intervention teachers for attending an after-school in-service training. The agenda and Web site information provided to those teachers is in Appendix B.

From a social marketing perspective, messages about calcium consumption included taste and convenience, peer influence, milk as a major source of calcium, and information on what constitutes a serving [12] were emphasized with intervention teachers. They were provided with print materials and Internet resources. The calcium-focused materials included a Web site on calcium for teens, developed and tested with children aged 11 to 15 years called "Clueless in the Mall" [11] and calendars and stickers from the National Bone Health Campaign, *Powerful Bones. Powerful Girls.*^{TM} [12] that were targeted to 9 to 12 year old girls and distributed to girls in the project. In addition to dairy calcium sources and the "Clueless in the Mall" Web site http://calcium.tamu.edu [11], other interactive Web sites such as http://www.powerfulbones.com [12] were

provided to support information and curriculum material used by the teacher. Print material was made available to the teachers and students to support the classroom instruction. *Calcium? Are You Getting Enough?* brochures [13] were provided for all students in the respective teachers' classes. Teachers were also provided copies of the curriculum *Exercise Your Options* [14] and *PYRAMID EXPLORER: Nutrition Adventures*™[15], a CD-ROM that makes nutrition education fun with game-like modules. For boys, Got Milk?™ skateboard key chains were provided. The in-service training for the intervention teachers was scheduled in computer labs to familiarize the teachers with the Web sites and other computer based materials.

Assessment of nutrition environment in all schools

Nutrition environment assessments were conducted in each school, intervention and control. The purpose was to determine the availability of food and beverages other than school meals during school lunch periods. All foods sold in canteens, vending machines - both in and adjacent to the cafeteria - and on other parts of the school campus were itemized. Food and beverage items sold on cafeteria lines in addition to the school meal pattern foods were also identified. Types of milk available and points-of-service were identified. Lists were developed of foods and beverages available during lunch. Temperature of milk being held for service was documented. Any unusual problems with breakfast or lunch schedules were noted. The purpose of the nutrition environment assessments was not to change the environment during the study, but to identify environmental differences among schools that could influence the study results. School

lunch and school breakfast participation data were compared with monthly historical data available for all schools in the study during the four-month period of the project.

Evaluation at student level

- Selected individual students
  - To determine if students in the selected classrooms from each grade level (6-8) changed consumption of calcium-rich foods, from dairy and other sources.
  - To determine if students in the selected classrooms from each grade level (6-8) ate breakfast either at school, away from school or did not eat breakfast.
  - To determine if student satisfaction in the school meal programs changed after the intervention.

Thus the intervention strategies were evaluated at the level of individual students in the selected classrooms.

Data analyses

The 24-hour food recalls were analyzed for energy and nutrient content (Nutritionist Pro™ 1.2, First DataBank, San Bruno, CA). Two registered dietitians, including the researcher, using copies of the 24-hour food recalls and nutrient analysis data sheets of specific food used by the school food service programs in the 20 schools, coded the information and entered it into the Nutritionist Pro™ database for analysis. Analysis was completed for each diet recall and for each class by gender, pre- and posttest, using the individual codes assigned to students. As a crosscheck, a sample number of the recalls, completed by each of the nutritionists, was reentered by the other nutritionist to verify the

accuracy of the data coding. Congruence between the coders was 94% for calcium, the nutrient of interest.

Data were generated from the School Foodservice Satisfaction Surveys (SFSS) including both the intervention and control schools. Pre- and post-intervention responses were analyzed to determine if there were differences in the individual students' responses to the 26 items surveyed, and if there were differences between intervention and control school students. Also analyzed were student's satisfaction based on their self-reported frequency of eating school meals. The University of Southern Mississippi, the institution that provides the analysis for the SFSS, provided a database of the data matched by student, pre- and posttest for both control and intervention schools.

Statistical analysis performed included determining means, univariate analysis of variance (UNIANOVA), chi square tests, stepwise multiple regression, Pearson correlations, and general linear methods (GLM) (SPSS 11, Chicago, IL). The primary focus was on the calcium intake per student in the two groups, intervention and control schools. SFSS results were also analyzed by intervention/control groups. GLM was used to test differences between intervention and control students' SFSS scores in overall satisfaction and the five factors related to overall satisfaction, food quality, staff, ambience, price, and time.

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APPENDIX D

STATE MAP SHOWING STUDY SITES

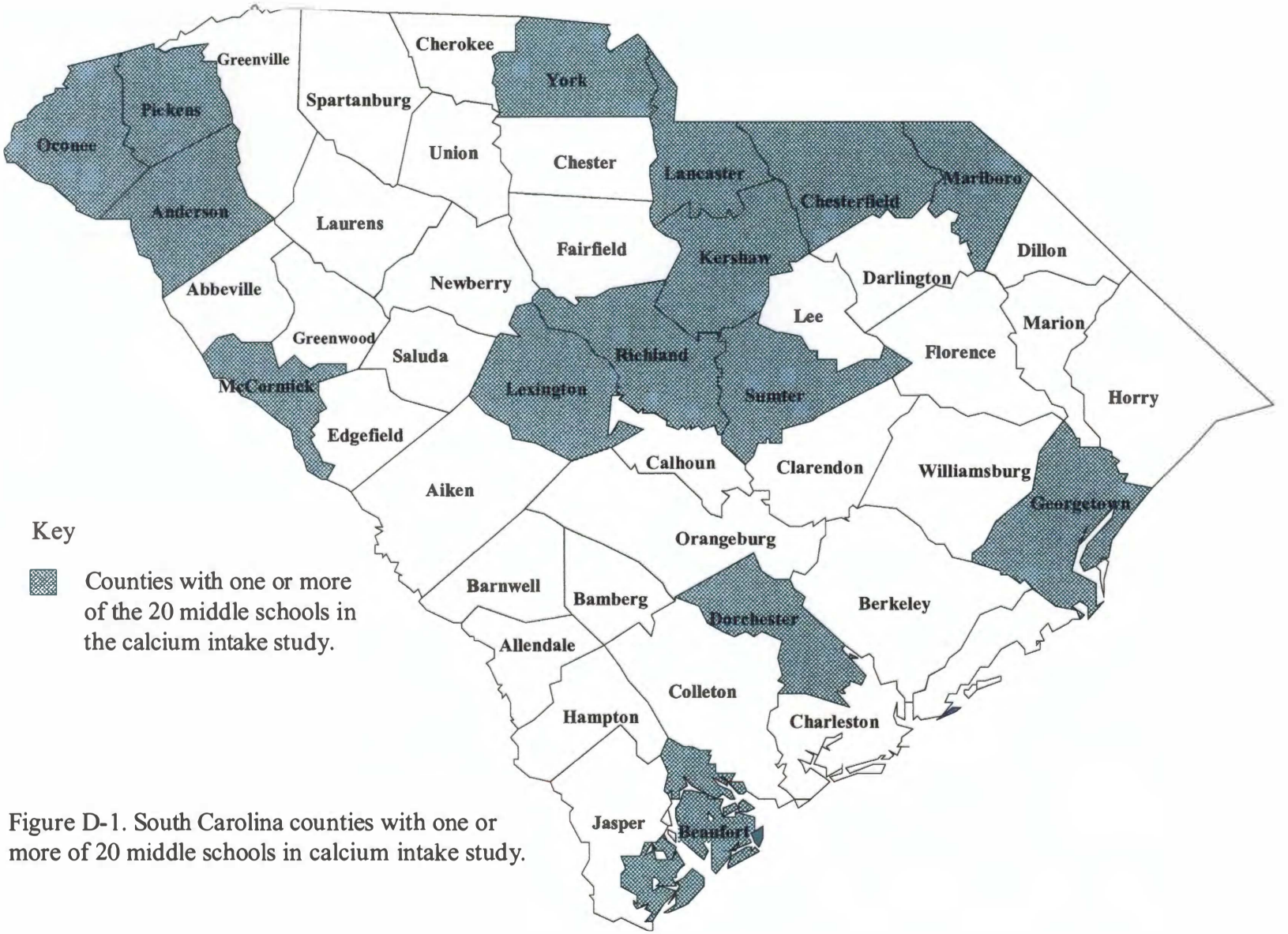

Figure D-1. South Carolina counties with one or more of 20 middle schools in calcium intake study.

APPENDIX E

MEAN STUDENT POSTTEST SCORES ON 26 SFSS QUESTIONS

Table E-1. Mean student posttest scores (± SD) [a, b] on 26 SFSS [12] questions by intervention and control schools.

Survey question [b]	Intervention		Control	
	n [c]		n [d]	
1. Overall, I am happy with the school foodservice.	536	4.30 ± 1.76 SD	414	3.91 ± 1.85 SD
2. The school menu includes food I like.	537	4.61 ± 1.75 SD	425	4.16 ± 1.77 SD
3. Main dishes on the serving line look good.	538	4.08 ± 2.04 SD	419	3.55 ± 1.97 SD
4. Servers and cashiers are polite.	528	5.09 ± 1.93 SD	414	5.06 ± 2.07 SD
5. School foodservice prices are OK for what I get.	520	4.23 ± 2.11 SD	395	3.96 ± 2.18 SD
6. I like how the food smells.	526	4.18 ± 1.86 SD	411	3.91 ± 1.86 SD
7. Servers and cashiers treat me with respect.	519	5.01 ± 1.90 SD	416	4.95 ± 2.00 SD
8. The dining room is cheerful.	512	4.51 ± 1.90 SD	411	4.53 ± 1.99 SD
9. The food serving lines are clean.	529	4.47 ± 1.93 SD	408	4.36 ± 1.93 SD
10. The noise level in the dining area is OK.	531	4.46 ± 2.02 SD	415 SD	4.33 ± 2.22 SD
11. Spills and trash in the dining area are cleaned quickly.	523	4.26 ± 2.05 SD	417	4.03 ± 2.15 SD
12. Students are not allowed to misbehave in dining area.	521	5.22± 1.89 SD	390	4.31± 2.10 SD
13. Servers and cashiers listen to the students.	509	4.40± 2.03 SD	415	3.78± 1.88 SD
14. I like how the food looks.	531	4.00± 1.84 SD	423	3.80± 2.01 SD
15. Tables in the dining area are clean.	532	4.42± 1.95 SD	422	4.35± 2.15 SD

Table E-1. Continued.

Survey question [b]	Intervention		Control	
	n [c]		n [d]	
16. Servers and cashiers smile and greet me when I am served.	536	4.35 ± 2.09 SD	395	4.12 ± 2.13 SD
17. Meal prices are reasonable.	496	4.28 ± 1.98 SD	413	4.16 ± 1.81 SD
18. I like the taste of the food.	528	4.39 ± 1.76 SD	411	3.35 ± 1.98 SD
19. Vegetables on the serving line look good.	515	3.62 ± 2.00 SD	411	3.35± 1.98 SD
20. I like the quality of the food choices.	524	4.20 ± 1.93 SD	407	3.71 ± 1.93 SD
21. The time given to eat once seated is OK.	536	3.68 ± 2.19 SD	417	3.55 ± 2.20 SD
22. The choices of food allow me to pick foods I like.	533	3.18 ± 2.03 SD	416	3.57 ± 2.10 SD
23. I like the quality of the main dishes (such as spaghetti and chicken.)	514	3.94 ± 1.89 SD	416	3.57 ± 2.10 SD
24. Total time given for meal periods is OK.	534	3.65 ± 2.03 SD	407	3.75 ± 1.99 SD
25. I like the choices of food offered.	532	4.06 ± 1.84 SD	416	3.32 ± 2.07 SD
26. I like the quality of the brands offered.	494	3.99 ± 1.95 SD	414	3.67 ± 1.95 SD

[a] Scale 1 = Low or least satisfied, 7 = High or most satisfied.

[b] Question 1 was overall satisfaction followed by 25 questions pertaining to 5 categories, food quality (11 questions: numbers 2, 3, 6, 14, 18, 19, 20, 22, 23, 25, and 26), staff (4 questions: numbers 4, 7, 13, and 16), ambience (6 questions: numbers 8-12 and 15), price (2 questions: numbers 5 and 17) and time (2 questions: numbers 21 and 24).

VITA

Vivian Bowie Pilant was born in Columbia, TN on March 13, 1941. She was raised in Columbia, TN where she completed grades 1-11. She completed the 12th grade in Key West, FL. From there she went to the University of Tennessee, Martin and received a B.S. in Vocational Home Economics in 1965. She worked for 2 ½ years as Director, School Food Services and Nutrition Education for Weakley County Schools in Dresden, TN before going to graduate school. She received an M.S. in Institutional Management at the University of Tennessee, Knoxville in 1970.

She was employed as a Coordinator of School Food Services for Duval County School Board in Jacksonville, FL from 1970 to 1975 when she moved to Columbia, SC to work for the Office of School Food Services, SC Department of Education as an area supervisor. From 1977-1979 she worked for the SC Department of Health and Environmental Control as the state nutritionist for the Women, Infants, and Children (WIC) program. She became the Director of the Office of School Food Services and Nutrition with the SC Department of Education in 1979, a position she currently holds and has held for 25 years.

She served as President of the American School Food Service Association from 1994-95; and Chair of the American Dietetic Association's School Nutrition Services Dietetic Practice Group from 2000-2001.

She received the highest civilian award in South Carolina, the Order of the Palmetto, awarded by the Governor in 1994. She is the recipient of the 1997 FAME Award for Friend of Child Nutrition; and the 1998 International Foodservice

Manufacturers Association's (IFMA) 1998 Silver Plate Award in the Elementary and Secondary schools category. She was the recipient of the Child Nutrition Foundation's Pre-doctoral ConAgra Child Nutrition Fellowship for 2002.